

**Factors involved in contributing to effective  
student learning when using  
Interactive whiteboard technology: A case  
study of a New Zealand primary school**

**By  
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**A thesis submitted in partial fulfillment of the requirements for the degree  
of  
Master of Computing**

**UNITEC New Zealand, 2009**

## **Dedication**

I wish to dedicate this work to my parents;  
Donald and Margaret Thornley, gifted educationalists in their own right.  
In the short time you were my parents, you instilled a love of learning which I  
carry with me each and every day.

## **Abstract**

Today's 21<sup>st</sup> century educational landscape is very different from previous centuries. Technology has had a major influence on this setting. With the call to prepare our students for the information age and a digital society, from a variety of stakeholders (government, employers, parents) in our children's education, New Zealand Primary schools are currently facing what could be the most momentous transformations in the way we teach our children in the classroom. As educators, we need to prepare the most important stakeholder in education, the student, to not only become an effective user of technology, but competent collators and processors of information with skills that will contribute to lifelong learning.

With limited operating budgets and long term strategic decisions required, school administrators are required to make important decisions about what is the best technology to incorporate into the classroom in order to meet these expectations from stakeholders. Whilst this research focuses on the use of Interactive Whiteboard (IWB) technology and the impact that the technology has on effective student learning and classroom strategies that contribute to this learning, the analytical methodology used in this research could be applied to any technological instructional device that will be used in the classroom for teaching and learning.

Many educationalists, including Beauchamp and Parkinson (2005), Hodge and Anderson (2007), and Smith, Higgins, Wall and Miller (2005), have made the call for authentic empirical research into the way in which IWB technologies are contributing to teaching and learning. This Case study research of a single New Zealand primary school encompassed a comprehensive look into a real situation, happening right now in New Zealand primary school classrooms. The Case study data collection took 13 months to complete and consisted of over 30 hours of classroom observations and 30 hours of interviews. To support and examine the data collected at the school, the researcher also interviewed the supplier of the IWB technology used at the case study school and attended the Inaugural New Zealand and Australian Interactive Whiteboard Conference held in Auckland in October 2009.

When carrying out the classroom observations, it was not the intention of this project to record the assessment outcomes of the lesson but rather to record and analyze the Interactive Whiteboard functionality used during the lesson and observe the classroom interaction between the technology, the teacher and the students that indicated effective learning opportunities were experienced. Observation field notes recorded the students' behavior and teaching and classroom strategies employed when using the IWB as a tool within a lesson. The analysis of the observed data was triangulated with data collected from interviews with the school leaders and teachers and with the current researched literature available on the use of IWB technology in the education sector. Supporting the analysis is a theoretical model (see Figure 5-4) modified by the researcher to identify effective learning principles and information processing skills that should be applied when using technology as a tool for optimum learning.

Whilst much of the research, both in this project and in the literature, is conclusive in identifying that the IWB technology contributes to the engagement of the student, the intention of this project was to look further into the other factors that were evident in contributing to effective learning. This research project did identify other factors, such as the IWB technology affords the possibility for teaching methods to reflect a more interactive and student centered learning opportunity, however in a number of the classroom observations these opportunities were limited because of the teaching pedagogy and classroom strategies employed.

The outcome clearly identified that the classroom still reflects an overbalance in power and control from a teaching perspective, which has an effect on the use of the IWB technology, resulting in teaching strategies that do not take full advantage of the functionality and the contribution it could make to effective teaching and learning for the student. If schools are to make the significant investment in this technology, a clear understanding is required from the teacher that pedagogy will require change and a new teaching paradigm is needed if students of today's generation are to benefit from the use of this expensive but highly valuable educational learning tool in their environment.

## Declaration

**Name of candidate:** Jacqueline Lindy Thornley

This thesis is submitted in partial fulfilment for the requirements for the UNITEC Master in Computing degree.

The regulations for the degree are set out in the Master of Computing Programme Schedule and are elaborated in the course handbook.

### Candidate's declaration

I confirm that:

- This thesis represents my own work;
- The contribution of any supervisors and others to this research is consistent with the UNITEC Regulations and Policies;
- Research for this work has been conducted in accordance with the UNITEC Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the UNITEC Research Ethics Committee. Research Ethics Committee Approval Number: 2008.812

Candidate Signature .....Date:.....

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- The research was carried out and the thesis prepared under my direct supervision;
- Except where otherwise approved by the Board of Postgraduate studies of UNITEC, the research was conducted in accordance with the degree regulations and programme rules;
- The contributions made to the research by me, by other members of the supervisory team, by other members of staff of UNITEC and by others was consistent with the UNITEC code of supervision.

Supervisor: .....Date.....

Supervisor: .....Date.....

## **Acknowledgements**

This thesis would not have been possible if it was not for the gracious and open attitude shown towards me by the case study school leaders and teaching participants. I wish to thank you for all for allowing me to infiltrate your environment for well over a year. Your openness, and support of this research project was fantastic.

I would like to thank my supervisor Professor Kay Fielden for her support, and direction in the process and completion of this thesis. Also, thanks to Dr Donald Joyce for your help with editing and referencing.

Thank you to my family, Richard and Ruby for your patience and support, and also to my many dear friends who have helped me with child care when I needed it.

## Conventions used in this thesis

**e-learning** - use of technology in support of the learning process

**e-learning fellowship** - Ministry of Education scheme to fund teacher release for one year to research student learning with ICT

**e-maturity** - level of understanding and effective use of technology for educational outcomes

**EMF** - electromagnetic field, an electrically charged field that is omitted from electrical devices and power lines

**Flipchart** - is a document type (.flp) used on the Promethean interactive whiteboards. These documents can contain rich text, images, graphics, video audio clips and other files all together in one file for administration

**Instructional Technology** - a technological device used in tandem with an educational application to contribute to effective teaching and learning

**ICNIRP** - Non-ionizing Radiation Protection

**ICT** - Information and technology communication

**IWB** - Interactive whiteboard, an interactive device that is connected to a computer and a projector

**IWBFQE** - Interactive whiteboard as a facilitator of quality education. Researchers modified model for analysis of effective use of the IWB.

**m-learning** - mobile learning environment

**Multimodal** - a term to describe the combination of multimedia technologies in the available software affordances

**Pedagogy** - the science of teaching, the process and methods that contribute to teaching

**RF** — radio frequency, a subset of electromagnetic radiation that transmits signals for devices such as radios, mobile phones, and wireless infrared devices

**Rich text format** - (.rtf) a file format that will save all text formatting and structures, so if opened in another RTF aware software package the formatting will be left intact

**SDL** - Student Directed Learning

**STEPS** - Study of technology in primary schools (Sali, 2009)

**TFQE** - Technology as a Facilitator of Quality Education. Theoretical model to assess technology and its contribution to quality education (Callahan & Switzer, 2004)

## **Conventions used in identifying Case Study participants**

<b>Principal</b>	Principal of the School	
<b>Associate Principal</b>	Associate Principal of the Senior School	
<b>Teacher 1</b>	Teacher one and ICT Coordinator,	Year 5 (9 – 10years)
<b>Teacher 2</b>	Teacher two	Year 4 (7-8 years)
<b>Teacher 3</b>	Teacher three (maternity leave)	Year 5 (9 – 10 years)
<b>Teacher 4</b>	Teacher four (maternity leave)	Year 4 (7-8 years)
<b>Teacher 5</b>	Teacher five (replacement)	Year 5 (9 – 10 years)
<b>Teacher 6</b>	Teacher six (replacement)	Year 5 (9 -10 years)



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## **Chapter 1      Introduction**

Over the last thirty years, there has been a steady flow of Information and Communication Technology (ICT) introduced into the New Zealand education system. During this time, there have been two ICT innovations that have had a significant effect on teaching and learning, the computer, and the internet (Bell, Shank, & Szczrybak, 2008). The first innovation, the computer introduced educational software to teachers and learners, and options for a variety of multimedia resources. With the influence of networking came the second innovation, the Internet, which extended the available teaching resources well beyond the school's environment. The fundamental change that both the computer and the internet have had on education is the opportunity for an interesting and fun way of achieving learning outcomes for students. It has been identified by Beetham (2007) that the learning outcomes for the students, with tools such as internet, virtual environments and simulations, widens the opportunity for discovery and broadens the learning outcomes. Today, many New Zealand schools have an assortment of ICT available for students, ranging from one or two standalone computers in the corner of the classroom, to specialized computer classrooms (pods) of networked computers, to a notebook/laptop as part of the required school stationary.

This research focused on a particular instructional technology, the Interactive Whiteboard (IWB). The IWB technology was first introduced into New Zealand schools in 2001. However, it is only in the last two years that we have seen a significant rise in the numbers implemented into New Zealand primary schools. However, the question that often underpins the introduction and implementation of ICT into the classroom is the return on investment contributing to improvements in student learning and effective teaching. Gillen, Staarman, Littleton, Mercer and Twiner (2007) suggest that often the technology is installed in classrooms with little thought and consideration given to the most effective way in which to use that technology to its best advantage for student learning. To date, there have been many challenges identified when implementing and using technology in the classroom for teaching and learning. Some of which are the lack of leadership and support from school leaders, limited ICT professional development opportunities for teachers, lack of access to hardware and software, time restrictions and

understanding of how technology fits into the school curriculum (Falloon, 1999; Lai, 1999).

These challenges have resulted in little use of ICT by teachers, and a cautious view of ICT as a useful tool for effective teaching and learning.

What effect is the IWB technology having on teaching and learning today? There has been very little empirical research here in New Zealand. In July 2009, an 18-month study, STEPS, which reviewed the impact of technology in 40 European primary schools was presented at the European Commission in Brussels (Sali, 2009). The study explored how ICT was affecting teaching and learning and one of the major issues raised in the findings of this study was the need for better-organized case studies that focused on the pedagogical use of ICT. This call for a better understanding of the procedures being used with the IWB technology is also supported by educational researchers (Beauchamp & Parkinson, 2005; Hodge & Anderson, 2007; Smith et. al., 2005) whose research papers have identified the obvious attribute of the IWB as a visually engaging resource for student learning, but further research is required into what other factors are contributing to student learning. In addition, at the inaugural New Zealand and Australian IWB conference held in Auckland in October 2009, Alison Gernhoefer, Principal of Westlake girls High School and host of the conference, summed up this need for further research in her opening speech with the following comment:

***“We need to know more about the impact of using this technology on teaching and learning, through rigorous research which goes beyond the anecdotal recorded. The technology[IWB] is expensive and quality information about its efficacy will give schools more confidence in investing in this technology, while we may think that we know intuitively that good things are happening in the classrooms where interactive whiteboards are being used, we need to know, using best evidence” (Gernhoefer, 2009, para 8)***

In a direct response to this need for evidence, this thesis will research real events within a primary school classroom. The purpose of this research is to identify those factors in a real-life situation that contribute to effective student learning when the IWB technology is used as a

teaching resource. It is intended that this research project will contribute to the current research literature on technology in the New Zealand education sector.

A qualitative research method has been selected for this research project, which is a case study of a single primary school in the Auckland region of New Zealand. This case study sought to examine in depth a contemporary phenomenon, being experienced at present by many New Zealand schools. The research is based on an interpretive epistemology that investigates a genuine experience, reviewing activities and patterns over a number of classes, while collecting and evaluating the attitudes, opinions, and motivations expressed in interviews with teachers who use the IWB technology as a teaching tool. This research project is an in-depth empirical examination of a practical situation. The case study was conducted over four school terms, from July 2008 to August 2009 (13 months). There were eight participants: - the Principal, Associate Principal and six members of the teaching staff. Two interviews were carried out with each participant. Over thirty hours of authentic classroom observations where the teacher was using the IWB technology in the classroom were documented. During these observations, the teacher, students and the environment in the classroom were observed in detail. The lessons observed were a variety of modules in the New Zealand primary curriculum; Science and Health, English and Language, Mathematics, Reading, Spelling and Comprehension and Written Language.

In order to understand and evaluate the data collected, this research will investigate the philosophy and approaches taken when teaching and learning with IWB technology. As the IWB technology is a current technology being introduced into the New Zealand educational environment, it is hoped that this research will benefit all of those who are involved in the ICT strategy planning, implementation and use of the IWB technology in the classroom

### ***1.1. Research questions defined***

To frame the research, the following questions have been posed:

- **How is the IWB technology being used to maximize learning opportunities for students?**

- **How is the IWB technology contributing to effective teaching and classroom strategies to support student learning?**
- **How has the introduction of IWB's in the classroom changed the physical learning environment for the teacher and student?**

As discussed by Yin (1989), a suggested way in which to enhance the credibility of case study data is to carry out the research in an operational and prepared manner, ensuring the steps taken to record the data could be transposed to another case with either the same or similar results expected. When looking into the criteria that will support the above research questions, the following criteria were determined to form field notes that could be used to research another instructional device if required, therefore supporting Yin's (1989) theory on establishing credibility for this research project.

### **1.1.1 Research criteria for observations**

These criteria were designed to elicit as much data and information as possible to collate a holistic and in-depth case study of how the IWB technology, either directly or indirectly is contributing to effective learning (see Appendix 1c). The following questions were posed:

- How is the IWB being used in the classroom as an ICT resource tool? This question was expanded to identify the structure, content and outcome of the lesson.
  - What is the lesson format?
  - What IWB functionality is being used?
  - Are there any technical issues?
- Were the ways in which the IWB technology is used contributing to student engagement and interactive learning?
  - What is the ambiance and atmosphere like in the room?
  - Are there visual signs of engagement and motivation?
  - How does the IWB usage fit with the models for technology as a facilitator of quality education?



- How has the IWB changed the delivery and teaching pedagogy of a lesson? Identify examples of teacher student interaction when using the IWB to facilitate a lesson.
  - How is the lesson delivered, formally or informally?
  - What types of teaching strategies are employed; teacher centered or student centered?
  - How does the IWB technology affect the teaching approach?
- Has the technology changed the classroom layout and function?
  - How has the technology changed the teacher and/or student physical interaction?
  - Is the IWB visible, can you hear the audio content?

### **1.1.2 Research criteria for interviews**

Each case study participant, school leaders and teachers were interviewed twice. Interview questions were a combination of structured and open-ended questions with the intention of uncovering authentic and existing attitudes, opinions and approaches to ICT, in particular the IWB technology and its contribution to teaching and learning. The first interview (see Appendix 1a and 1b) discussed demographic information, attitudes and approaches to ICT in general and was primarily intended to create a rapport with the participant before undertaking the classroom observations. The second interview (see Appendix 1d and 1e) with school leaders and teachers was undertaken after the classroom observations had been conducted and sought to investigate and clarify any teaching and learning opportunities identified during the classroom observations.

Examples of the criteria that formed the questions used in the interviews' are shown below:

- What is the experience, opinions, beliefs and attitudes of the school leaders and teachers towards ICT and in particular the Interactive whiteboard?
- What is the ICT strategy in the school?
- How does the school support the ICT strategy?
- What support is there for ICT professional development?

- Is the ICT infrastructure supportive of IWB technology?
- What are the leader's and teacher's attitudes towards the ICT and in particular the IWB technology?
- What is their understanding of learning theory and models for effective learning and the correlation for implementing and using ICT?
- What is their opinion of the IWB and its contribution to learning?
- What is their opinion on 21st century students and learning?

## **1.2 Chapter Summary**

This chapter identified the need for empirical research into the effective use of technology in the classroom, and in particular, what factors contribute to the best opportunities when using the IWB for student learning. To clarify and frame the research the three main questions that formed the basis of this research are identified:

- **How is the IWB technology being used to maximize learning opportunities for students?**
- **How is the IWB technology contributing to effective teaching and classroom strategies to support student learning?**
- **How has the introduction of IWBs in the classroom changed the physical learning environment for the teacher and student?**

To answer these questions, the research expanded on the criteria that will contribute to gaining relevant data to answer these questions, which in turn formed the observation field-note questions and the participant interview questions for pre and post observations. (see Appendix 1a, 1b, 1c, 1d & 1e)

In the next chapter, the main three types of IWB technology found in New Zealand schools will be identified, and the technical attributes explained.

## **Chapter 2      What is an Interactive Whiteboard Technology**

### **2.1 *Introduction***

Whilst some of us can remember back into the past, where teachers used a blackboard and chalk, most New Zealand primary schools are now fitted with static whiteboards that are used to list instructions, notes and drawings. Today, the static whiteboard is now being superseded. IWB technology was first introduced overseas in the 1990s. However, it has only been seen in New Zealand classrooms since the year 2001. The IWB consists of a minimum of four main components, a whiteboard, a computer, a data projector and specialized software.

As the name suggests IWB technology brings a static whiteboard to life. As the board is attached to a computer, anything that is available on the attached computer can be displayed via the projector onto the whiteboard. This projected image can then be activated, by finger touch (resistive technology), the computer keyboard, wireless pens or wand type pointers (electromagnetic technology). Additional interactivity can be carried out with handheld remote response devices such as wireless slates and voting devices that teachers and students can use within the classroom environment.

In New Zealand, there are three main types of IWB technology found in classrooms. When the market share of each type of IWB in NZ classrooms was sought, this information was not readily available. However, in a recent interview with Marnie Etheridge, the National Manager of Promethean Activboards, she advised that the IWB technology is harder to sell today than it was two years ago. In her opinion, school management is more cautious with their IT spending today. In questioning Marine on the number of Promethean IWBs in New Zealand schools, she was not willing to divulge this information (see Appendix 4 for questions in interview with Marnie Etheridge).

## 2.2 Electromagnetic technology



*“The Activboard is a solid state impact resistant white board which can be operated with an electronic pen which emits a small magnetic field. The movement of the pen and its magnetic field is picked up by the frame of the board or the grid of wires embedded the board.” (Chin, 2004, p. 79)*

Termed hard technology, because of the solid board, examples of this technology are the Activboard by Promethean. First introduced to NZ schools in 2001, the educational market share is steadily growing. Price indications for this technology start at \$8,000.

Figure 2-1 Electromagnetic Whiteboard -Promethean Activboard  
(<http://www.activboardnz.com/Products/activboard+2.html> )

## 2.3 Resistive membrane technology

*“This whiteboard consists of a dual membrane resistive board that has a soft, flexible surface. The two layers of resistive material are separated by a small gap that creates a touch-sensitive membrane. The movement of a specialized pen is tracked by detecting the pressure of the marker against the surface. However, since the membrane is touch, sensitive, it is just an easy to control actions with a finger or fingertip in place of the pen” (Chin, 2004, p. 80)*



Figure 2-2 Resistive membrane technology – Smart board  
(<http://www.electroboard.com.au/products/detail.aspx?ID=16739>)

Termed soft technology due to the flexible surface of the board, an example of this technology is the Smart Board. Smart Boards are used extensively in the New Zealand educational sector. Starting price indications for this technology are \$5,000.

## 2.4 Infra-red technology

*“The infra red scanner is attached to the side of the board and movement is tracked through the use of special electronic pens which have uniquely encoded sheaths that enable the scanner to detect their position and pen color. When the user touches the board, the LED beam is broken and the absence is signaled back to the PC port via the main control board” (Chin, 2004, p. 81)*



Figure 2-3 Infra-red whiteboard - Infinity Board  
(<http://www.watermaninnovations.co.nz/web/>)

An example of this technology is the Mimio Interactive, which is portable and can be attached to any surface, to become interactive with the use of a pen. Advertised as New Zealand’s most affordable interactive whiteboard technology, prices start at \$1575.

## 2.5 IWB Functionality

In general, the IWB functionality includes:

- Access to any software or resources that are available on the attached computer
- The opportunity to capture electronically notes or images written on the whiteboard
- Click and drag of objects, images and text, annotating or marking up a presentation
- Translating written notes into text (on some IWB’s)
- A multitude of useful teaching tools such as hide, reveal, magnify, sound and video.

## ***2.6 Specialized software and handheld response devices***

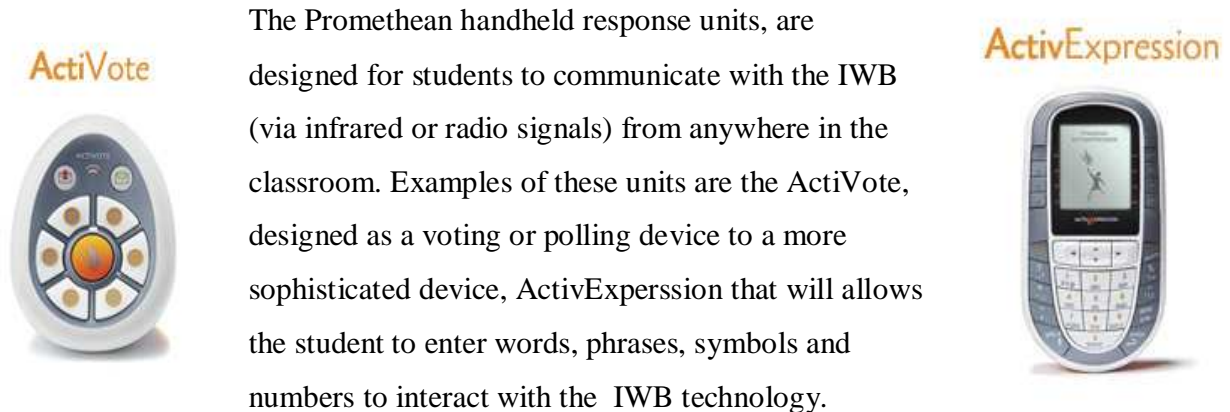
Whilst all of the IWB technology comes with specialized proprietary software and drivers for running the interactive setup, there is evidence of a growing market for vertical interactive whiteboard software. The case study school utilizes a number of websites that have a repository of available IWB multimedia resources, in particular the New Zealand Online learning centre that offers teachers a web portal of educational material specific to our learning areas ([www.tki.org.nz](http://www.tki.org.nz)).

At the recent inaugural New Zealand and Australian IWB conference, held in Auckland in October 2009, there were an equal number of software vendors and hardware vendors, promoting their interactive educational software. Companies such as Dataworks, Sunshine media, Pearson Education and Edsoft were all providers of e-learning IWB interactive applications for a variety of curriculum areas from year 1 to tertiary level.

All of the vendors of IWBs offer additional hardware devices, which complement the existing technology. Slates allow the teacher and students an opportunity to control the IWB from anywhere in the room. Handheld remote devices are promoted as the next step in allowing increased interactivity from students. They also allow the teacher to not take centre stage at the front of the room, but to facilitate learning from anywhere in the classroom.



**Figure 2-4 Manzano Wireless Tablet**  
([http://www.manzana.co.nz/html/solutions\\_access.php?sector=educ](http://www.manzana.co.nz/html/solutions_access.php?sector=educ))



The Promethean handheld response units, are designed for students to communicate with the IWB (via infrared or radio signals) from anywhere in the classroom. Examples of these units are the ActiVote, designed as a voting or polling device to a more sophisticated device, ActivExpression that will allow the student to enter words, phrases, symbols and numbers to interact with the IWB technology.

**Figure 2-5 Handheld Wireless voting and expression devices**  
(<http://prometheanworld.com/server.php?show=nav.16>)

## **2.7 Chapter Summary**

This chapter summarizes the main three interactive whiteboard technologies found in New Zealand schools today, electromagnetic, resistive membrane and infrared technology. The costs of the technologies vary from \$1500 to \$8000.<sup>1</sup>

Whilst the basic IWB setup consists of an interactive whiteboard attached to a computer and projector, additional handheld response units are now available to increase student activity and mobile facilitation for the teacher. Each IWB comes with specific software and drivers, however there is a rapidly growing market of available e-learning software designed to run on the IWB technology.

The next chapter reviews the literature used to form and frame this research project.

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<sup>1</sup> Costs of IWB technology as at October, 2009

## Chapter 3 Literature Review

### 3.1 Introduction

In 2009, New Zealand Statistics identified that 80% of New Zealand households had computers with access to the internet, an increase from 65% in 2006 and 37% in 2001. Today our students are referred to as **connected** learners. Connected learners have opportunities to link to a variety of digital educational resources, internally in the school environment and externally from the classroom. New Zealand Statistics reported in 2006, that 65% of New Zealand schools have desktop computers, 27% have laptops, and nearly two thirds of these schools have access to the Internet. This project and thesis will look at one current piece of information and communication technology (ICT) instructional device, the Interactive Whiteboard (IWB) and identify what impact this technology may have on student learning. Even though it is now widely understood by the education sector that children must have the skills to use technology to become active users in society, there is a need for more meaningful discourse amongst educators about students having a more holistic understanding of ICT. Not just to focus on the technical “know how” skills required to use ICT but the importance of preparing our students with “*lifelong*” information processing skills required to access and use to the best advantage the immense amount of information available to us through the use of ICT.

*“As the job market demands ever more flexibility and currency, post compulsory education has been reorganized around a model of constant updating of competence, also called continuous professional development. These changes have usual been driven by education department directives, or the demands of professional bodies and employers, rather than by learners themselves” (Beetham & Sharp, 2007, p 5).*

The focus of this literature review is to clarify the position that the participants in this research project find themselves in as part of the New Zealand educational landscape. By reviewing the literature on the stakeholders in education, the history of ICT in New Zealand schools, the past and current successes and challenges of using the IWB technology in the classroom, learning theories and their relevance on ICT, and the e-maturity of the case study school, the context in which this research project is conducted will be clarified.



## 3.2 Literature Map

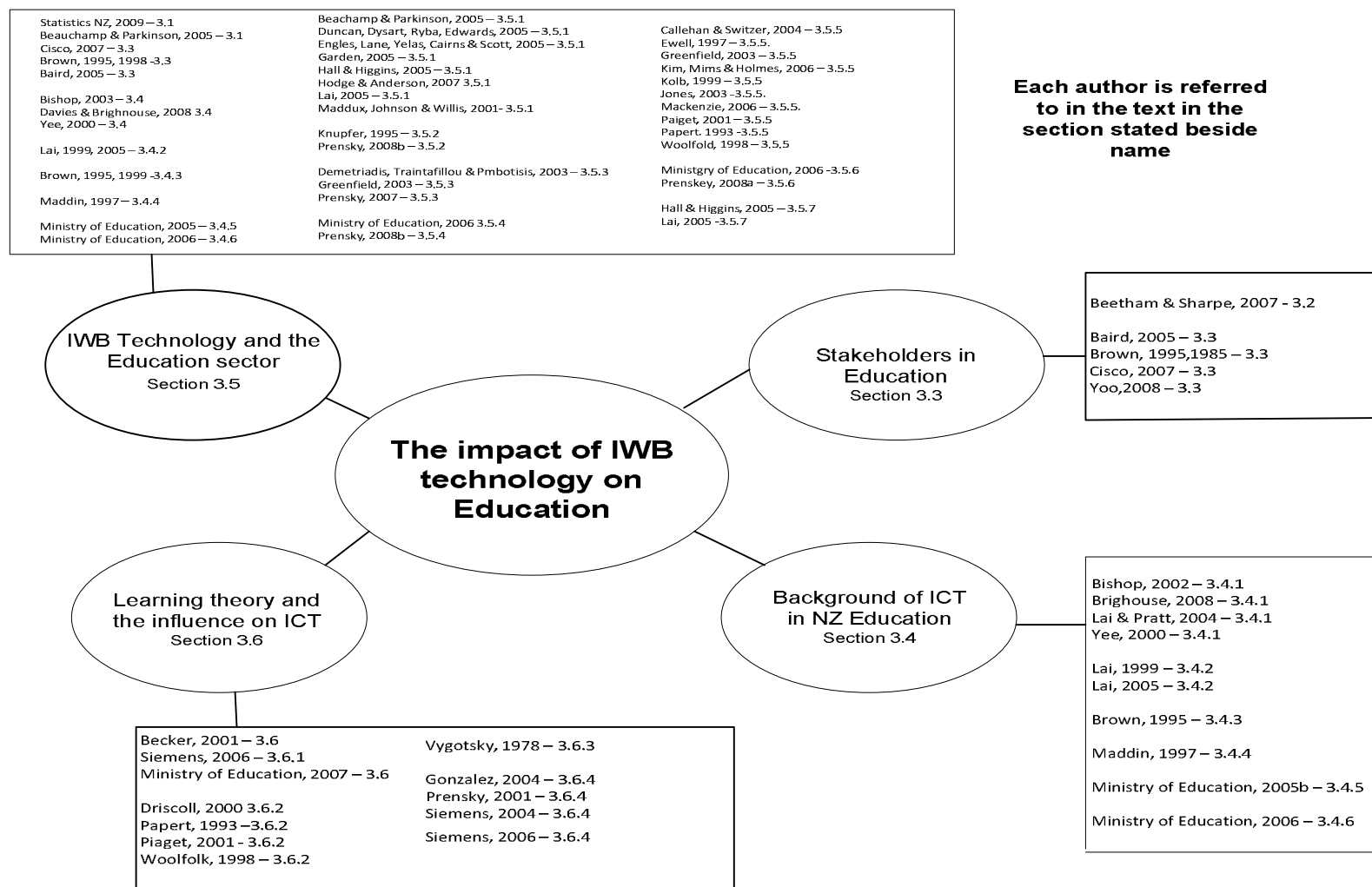
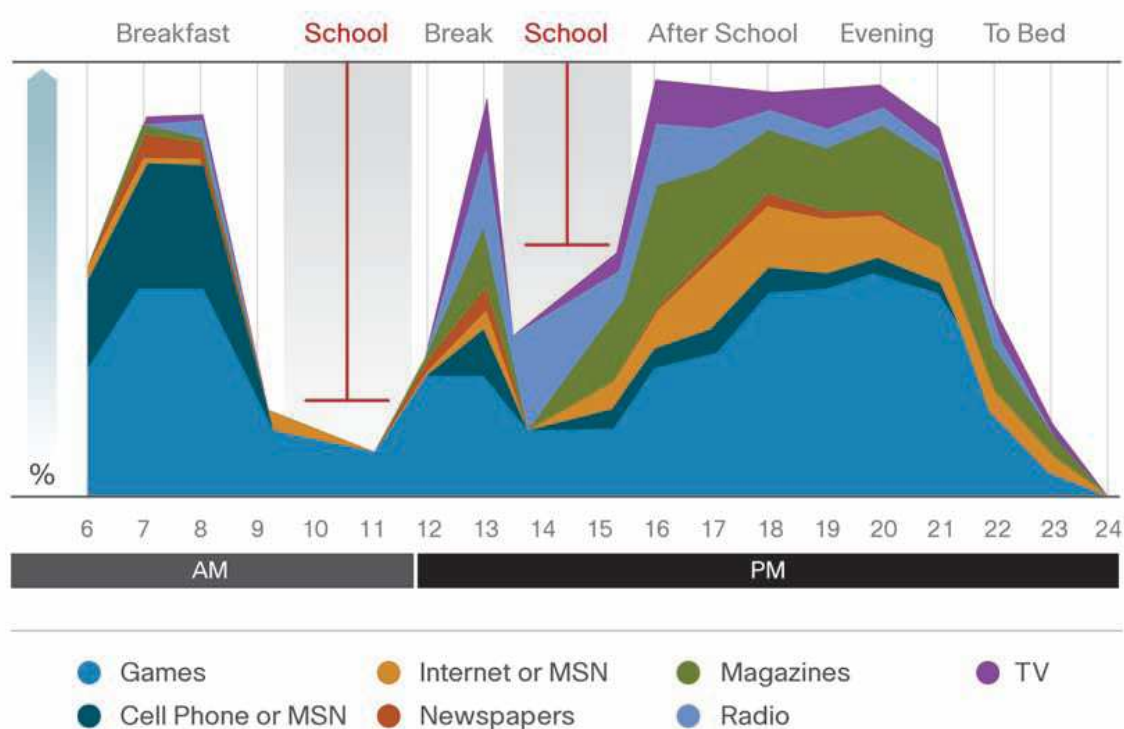


Figure 3-1 Literature Map

### 3.3 Stakeholders in Education

At the recent Inaugural New Zealand and Australian International IWB conference, held in Auckland New Zealand in October 2009, Stephan Jury, Vice Chairperson of Promethean IWB identified the classroom as the only place where students of today disconnect. Jury discussed the recent research (see Figure 3-2 below) where students use a number of technological mediums as part of their normal day's activity, but in the classroom have little or no opportunity to use ICT.

Media Consumption by Percent



Source: Cisco 2007

**Figure 3-2 The classroom is the only place where learners disconnect.**

Figure 3-2 above illustrates the average Dutch students' modes of connection outside of the classroom. The graph shows up to 50% of the connected time for students is spent playing games. Whilst game playing and its contribution to learning are currently being debated, Figure 3-2 clearly indicates the current use of digital technology that students use and communicate with on a daily basis. The question for many educators is, if the students use technology

extensively outside of the classroom, then why do we not provide the same opportunities for students to have hands on use of ICT in the classroom, what appears to be a natural mode of communication for them?

Whilst leading New Zealand educational researcher Dr Mark Brown (1995, 1998) has researched extensively that ICT can offer vast resources and contribute to the wider landscape for gaining knowledge, he has also identified that not every experience with ICT will contribute to an effective learning experience. Although ICT can provide interactive and motivational opportunities, we cannot be sure that amongst the vast amounts of information available, children are developing appropriate critical thinking skills in order to focus, evaluate, and reflect on the necessary or required information in the wider learning landscape (Baird, 2005). With current stakeholder expectations on the educational sector to implement technology to ensure students are confident and active technological users, school leaders and teachers are also responsible for ensuring, when using technology, that students are guided and managed to critique, evaluate and present effective learning materials.

In order for this research project to be placed in context, it is necessary to review the evolution of ICT in the New Zealand education sector and highlight the significant milestones that have contributed to the current position that the case study school finds itself part of.

### ***3.4 Background of ICT in NZ education***

New Zealand primary schools first saw the introduction of computers into the classroom in the early 1980s. Primarily, teachers drove this move by exercising their personal interest in technology, whilst acknowledging that technology may have a use in learning and teaching. Initially, most computers were installed as standalone devices, and were mostly used by the teacher for classroom administration and by the student for simple task-based learning, such as typing up a story in word processing.

As the interest grew, many schools installed computer pods, dedicated classrooms where a number of computers were networked together in simple peer-to-peer topologies, so lessons

could be taken collectively, often with two children to one computer. Lessons were again simple task-based predetermined outcomes. Many now saw schools as active users of ICT, however, in reality many teachers in everyday practices in the classroom were still floundering and not convinced that ICT was contributing to good teaching and learning. The following are some of the issues documented at that time.

### **3.4.1 Support and direction from school leaders and management**

Ensuring school leaders support technology as a tool in education has been one significant issue, that has been documented as critical to uptake of technology in classroom and school (Bishop, 2002; Yee, 2000). If the leaders of the school were seen as modelers of ICT use and provided a supportive and directive structure for ICT within the school, this behavior was more likely to permeate through the rest of the staff.

Then, like now, the operating budget for many New Zealand Primary schools lacked the funding for specialized roles, such as an ICT coordinator. This staff position as ICT exemplar and supporter often fell on the most enthusiastic staff member that showed the most interest in technology. In a study conducted by educational researchers into the roles, successes and challenges facing the ICT computer coordinators in 21 New Zealand schools, Lai and Pratt (2004) identified that teachers were challenged to find time to do justice to this role of ICT coordinator alongside their existing teaching role.

Today, leadership support for technology is still identified as crucial. However, for an ICT strategy to permeate and become fundamental to the culture of the school, the strategy requires collective action from all staff members in the school. In their book, *Creating Passionate School Leadership*, as identified by Davies and Brighouse (2008) is the key to transforming the vision for into action. Furthermore, Davies and Brighouse suggest school leaders need to progress from a management role to ensuring their students' learning outcomes are a priority.

### **3.4.2 Laptops for principals and teachers**

A lack of access to technology coupled with time constraints were often identified as barriers to understanding and becoming confident in using technology as a resource in a lesson (Lai, 1999). This lack of resources and limited time to experiment free from the daily commitments within the classroom led to a strategy from the Ministry of Education to supply teachers with laptops that they could use at home and in the classroom.

In early 2000, the Ministry of Education funded “*Laptops for Principals and Teachers*”, an initiative that subsidized the funding for laptops for principals and teachers. Whilst this initiative did contribute to increasing the user’s confidence, schools did not see the expected increase in integration of technology in the classroom that was expected. Although the teacher’s skill levels increased in the majority of management and administration tasks, there was still little evidence in the teacher’s mind that ICT could contribute to an effective learning experience. This could be explained by Lai (2005) who identified some of the myths and realities that surround teachers and their use of ICT, and suggest that the pedagogical benefits of using the technology are fundamental to successful use of ICT in the instructional process.

### **3.4.3 ICT Professional development**

As discussed by Brown (1995), in the past the Ministry of Education has struggled with defining the meaning of ICT in the school curriculum. The distinction between the technology itself and the knowledge of how technology can contribute to effective learning was identified as a missing link to the successful implementation of technology into the classroom. This uncertainty made it difficult for teachers to integrate technology into the learning areas within a school day. Brown concludes that ICT professional development is essential for teachers on an individual level:

*“Teacher education is essential. Ask teachers to identify their own individual needs and link these to theoretically informed professional development activities. Spend as*

*much money on teacher education as you spend on the costs of getting wired” (Brown, 1999, p. 38).*

Under pressure to provide teachers with the support they needed in developing their ICT use and experience, the Ministry of Education launched the **ICT Professional Development Program (ICTPD)** in 1998. Schools applied for funding as part of a cluster of four or five other schools within their community and collectively undertook ICT professional development classes. The collaborative nature of this cluster program was intended to create a supportive environment between schools, whereby they could share and develop their ICT experiences. Schools were required to assess their current needs, and participate in a number of programs using ICT for learning and teaching. These activities resulted in an ICT/e-learning strategy plan for each school. Along with up-skilling staff in the use of ICT, the pedagogical understanding of incorporating and using technology in the classroom was seen as a high priority.

Although participating in ICT professional development may have improved the class administration skills of teachers by introducing ICT as a tool for recording and collating prepared documents, the incorporation of technology as a learning resource for students in the lesson plan was still limited. In the mid 1990s, many schools saw the introduction of the Internet in their school. This opened up the classroom to a wide variety of research tools and global learning environments. With increasing pressure to ensure technology is an inclusive part of our education system, the Ministry of Education assisted many schools in upgrading their ICT infrastructure, increasing connectivity and improving internet access.

#### **3.4.4 Networking infrastructure**

The **Schools Network Infrastructure Project**<sup>2</sup> involved implementing quality cabling, switches, servers, and computers to provide robust networking environments within NZ schools. However, along with this improvement of the technology infrastructure, there was a required

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<sup>2</sup> Information of the Schools Network Infrastructure project can be obtained from <http://www.minedu.govt.nz/index.cfm?layout=document&documentid=9680&data=1&goto=00>

level of technical support needed. Many schools experienced issues with technical support for hardware, software and network management.

Even though schools were working towards a fully optimized technological infrastructure and environment, there was still a lack of evidence that this infrastructure was benefiting the students and their learning. As all users of technology know, it can be very frustrating when technology breaks down, especially when the lesson is dependent on technology and the teaching and learning is stalled because of the breakdown. Whilst technical issues are a fact of using technology, educational technologist Ellen Maddin (1997) suggested it may be essential that teachers are educated with basic troubleshooting skills within the classroom environment. These technical troubleshooting skills were thought to assist the teachers in offering a technically enabled learning environment.

In the last five years, there has been further upgrading to existing school networks as **Project Probe**, a joint initiative between the Ministry of Education and the Ministry of Economic Development that provided many rural schools with the opportunity to upgrade broadband capability with a variety of technologies DSL, wireless and satellite links.

### **3.4.5 E-learning fellowship study award**

In June 2003, the Ministry of Education established a study award named the e-learning fellowship. This scheme funded teachers for relief from teaching duties for one year to carry out research in ICT and education. The participants identified areas of research in which they were interested, so that they could conduct projects at their own schools. During this time other researchers, academics and other business related partners mentored and supported the participants in their research. Each year the participants met to participate collaboratively in each other's research and attend professional development workshops.

The scheme had two goals, to identify the learning that occurs when using ICT in the classroom environment or activity, as well as providing a reflective formative learning experience for the participants. The projects were documented for the wider community. The scheme is currently in

its 5th year and details for the projects undertaken so far can be seen on the following website: (Ministry of Education, 2005) <http://elearningresearchnetwork.ning.com/page/efellows-1>

### **3.4.6 Ministry of Education's E learning action plan**

As in most western countries, there have been a number of strategies, plans and initiatives in New Zealand directed at equipping students with the desired skills and understandings to participate in the 21<sup>st</sup> century. Together with school stakeholders, employers and parents, the New Zealand government promotes ICT literacy as a necessary requirement for all participants in society. As schools in the past have educated students to read and write, students of today are expected to finish their schooling ICT literate. In 2006 during a Labour-led government, the Ministry of Education released the action plan *“Enabling the 21<sup>st</sup> Century Learner: An e-learning Action Plan for Schools 2006-2010”*. This plan outlined the actions, outcomes, goals and directions for New Zealand schools to promote teaching and learning through the effective use of information and communication technologies over a four-year period. Particular emphasis was placed on the five key ICT competencies for students:

- *“relate to others*
- *increase feedback and self-assessment*
- *work interactively with local and global learning communities*
- *pursue knowledge*
- *represent, negotiate and communicate ideas in a creative and critical way”*(Ministry of Education, 2006, p. 5).

Although the Ministry of Education's e-learning action plan could be seen as an adoption model for all New Zealand schools, effective ICT practices and infrastructure vary from school to school.



### **3.5 IWB technology and the education sector**

Whilst IWB technology has been used in the business sector since the 1990s, the first IWB technology (Smartboard) was introduced to a New Zealand classroom in the year 2001. Over the last five years, many schools have implemented the IWB technology and this has had a significant influence on a number of the following aspects in the educational environment.

#### **3.5.1 Changes to classroom management and teaching pedagogy**

In 2004, a research division of the Ministry of Education, Digital Opportunities (Digiops) funded a project called **Project ACTIVATE**. This project saw 5 Auckland schools and 10 Southland schools pilot the use of the IWB as part of their classroom activities. As a result of this project ACTIVATE a number of schools published articles (Duncan, Dysart, Ryba, & Edwards, 2005; Engles, Lane, Yelas, Cairns, & Scott, 2005; Garden, 2005). Conclusively, this research identified that when managed and facilitated properly, using an IWB as a tool in a lesson contributed to greater teacher/student interaction, clear engagement of the students and encouraged a collaborative learning environment for all. These results were substantiated by researchers Beauchamp and Parkinson (2005) and Hall and Higgins (2005) who looked at the way UK Primary schools were using the IWB and the impact on the classroom. They also concluded that IWB technology was preferred and favored by both students and teachers as a tool for engagement and motivation. However, they did highlight there was a need for more in depth research, to look past the “*Wow factor*” (Beauchamp & Parkinson, 2005) and investigate teaching strategies and the functionality of the IWB.

Firsthand experience of how the IWB technology had the potential to over excite its users on its initial use was also documented here in NZ. In recording the implementation of the IWB technology into her South Auckland classroom, teacher Sue Hodge (Hodge & Anderson, 2007) wrote of her initial fascination and capacity to be overawed with the technology as a significant part of the learning curve when implementing IWB technology into the classroom. On reflection (identified as her “**nodal moment**”) of her implementation and use of the IWB technology,

Hodge was clear that her teaching style and delivery was reverting to whole class teaching, one-way presentations and a didactic delivery of the lesson when using the IWB initially. Adding to this realization was the lengthy ‘mat’ time students experienced and the neglect of other mediums such as writing and reading because of the IWB’s overuse. As Sue explained, not only was she ‘blinded’ by the technology, but also so were the children.

Maddux, Johnson and Wills (2001) explored an advancing array of technologies in education and identified the “*Everest Syndrome*” where users rush into using technology in an educational setting because it is available, but with little thought as to how it contributes to effective teaching and learning. Cuban (2007) debated the function of technology in the classroom, and highlighted the following three questions that teachers should ask to help clarify their intentions and attitudes before they use technology in the classroom:

- *“What do you want students and teachers to achieve in the classroom from the use of ICT?”*
- *Can we reach the same goals with less cost without additional investments in technology?*
- *What configuration of hardware, software and internet connections would best meet your goals and the projected use of computer?” (as cited in Lai, 2005, p. 15).*

### **3.5.2 Changes to teaching strategies when using technology**

When using ICT in the classroom, a fundamental understanding of how the technology will affect the pedagogy of teaching is essential for effective use of the technology. One of the most significant and widely debated philosophical changes resulting from using ICT and still a major adjustment for many, is the concept that the teacher is not the repository of all information or expert of all topics. For many, the role that the teacher plays in the classroom with the use of technology is a change from the sole provider of knowledge to the facilitator and manager of the learning process. When using technology as a resource tool in a lesson, it is suggested that the

technology could be seen as another facilitator or educator supporting the teacher in their delivery of knowledge.

In addition, the teacher-student relationship is *forced* to change when using technology. This change in teacher-student relationship is not a new theory. Educationalist Nancy Knupfer (1995) wrote about the suggestion that the teacher's role when using any form of technology requires significant alteration; from a sole teacher didactic delivery experience to allowing the student to become more active and take control of their own learning. This change was seen to require teachers to release some of their control and authority and to adopt a more collaborative role in their teaching approach, thus guiding and supporting students towards their learning outcomes.

This resistance from teachers in releasing their control within the classroom is still a hotly debated topic. In a recent paper, educational technologist Marc Prensky suggested that this letting go of authority could benefit the teacher and remove their need to be the sole technologist in the classroom, but allow the student to take on the responsibility of using the technology to their advantage.

*“Many teachers resist being taught to use technology. This also makes sense – teachers should resist, because it is not they who should be using the technology to teach students, but rather their students who should be using it, as tools to teach themselves. The teacher’s role should not be a technological one, but an intellectual one – to provide the students with context, quality assurance, and individualized help. (Of course, those teachers who love technology are free to learn and use it” (Prensky, 2008b).*

### **3.5.3 Changes to the student role in education when using technology**

Technology has an effect on the student's role in education. With a wide number of written resources such as books to the wider opportunities for information gathering through technology, students require good information processing skills if they are to incorporate and use technology in their daily lives.

Students need the skills to become good processors of information and skills to become **“lifelong”** learners to find the required knowledge, as it increases in availability, and be particularly adept at evaluating the source and relevance of the information.

The majority of this project’s case study students have grown up within a digital environment that includes computers, mobile phones, the internet, and gaming devices. With many of these devices offering learning opportunities, as a recipient the student’s role has changed and the obvious question here is *“should the school environment reflect this digital world?”*. With advancing internet technologies and tools the learner has no limitations, subscribing to the constructivist learning approach, where they are seeking knowledge to meet their needs, where and when they need it.

Educational technologist Marc Prensky has been a long-standing advocate of the theory that a digital approach to learning is well overdue for many education providers. He suggested that schools who provide a digital environment that includes a range of multimedia tools, such as video, animation and audio aids, coupled with a hands-on interactive experience for students, are providing a classroom environment suitable for students of today, in particular the Y and Z generation (born after 1984 to now). Prensky (2007) supported the theory that the use of multimedia technology in education contributes to the motivation and engagement of the student in their learning experience.

This endorsement of a digital multimedia learning environment is supported by Demetriadis, Traintafillou and Pmbotisis (2003) in their research that focused on students’ attitudes to learning with multimedia. Demetriadis, Traintafillou and Pmbotisis labeled this learning opportunity as the **“Dual coding theory for learning.”** It was their opinion that when there is a combination of multimedia formats, such as animation, video and sound, combined with student interaction within a lesson, there are clear results seen in the student’s ability to process the information effectively and retain the information for longer.

However, neuroscientist Susan Greenfield (2003) argued that modern technology is changing the way the brain works and that technology is not the proponent of accelerated learning as

originally thought. Greenfield outlined her concern that electronic devices used everyday both in the classroom and outside are having an impact on the micro-cellular structure of the brain. This change is specifically about reducing attention span. Greenfield argued that technology contributes to information being processed in small bytes, instantly and quickly with the increased attraction to visuals and sound (multimedia).

In research conducted at Harvard Medical School, Greenfield cited an example of how the brain can be influenced very quickly, in an experiment using a group of adult volunteers when they were learning the piano. None of the participants could play the piano before the experiment was conducted. The participants were divided into three groups as follows:

*“The first group were taken into a room with a piano and given intensive piano practice for five days. Over five days, the second group were taken into an identical room with an identical piano, but had nothing to do with the instrument at all. The third group was taken into an identical room with an identical piano and were then told that for the next five days they had to imagine they were practicing piano exercises. On analysis of the results, it was unsurprising that the participants who had performed the piano exercises saw changes in brain structure in the areas of the brain associated with finger movement. However, what was really surprising was the third group of participants who merely imagined doing the piano exercises saw changes in brain structure that was almost as pronounced as those that had actually had lessons” (Greenfield, 2003, p. 153).*

This experiment shows that the brain can change its cells and functional area size, within a short time just by thinking, and being part of experiences every day. Therefore, with the inconclusive results on the effect technology has on student learning and the effect that it has on the students brain, there is an urgent need more than ever for research to be undertaken into the learning process and the way in which we incorporate technology into that process.

### **3.5.4 IWB functionality - Opportunities for collaborative and dynamic learning**

In a constructivist approach to learning, it is generally accepted (Haldane, 2007; Jewitt, et al., 2007) that students learn from any immediate groups to which they are exposed. Younger group participants are shown alternative ways at looking at things, and older participants may demonstrative leadership roles, all of which contribute to learning in a collaborative environment. Because all students come to the classroom with a variety of tacit knowledge because of their past and current experiences, when a subject is introduced into the class, effective use of the IWB functionality can contribute to the transfer of knowledge amongst all in the classroom.

Haldane (2007) stated that when IWB functionality is fully utilized during a lesson, modifications, changes of direction, including other materials such as video clips or graphics then an engaging and dynamic lesson can expose students to a variety of learning opportunities.

### **3.5.5 IWB Functionality -Opportunities for timely feedback and reflection**

Although the desired outcome may be reached when teaching with conventional methods; handouts, books, and static whiteboard, the flow of the lesson is often significantly more delayed with the traditional tools for teaching. The IWB technology can reduce this delay and interruption of content and provide the student with timely and frequent feedback. This opportunity for learning in a timely manner suits the student, who more often than not wishes to deal with the matter at the current time not later that day or even the next day (Callahan & Switzer, 2004). Ideally, presentations should be brief, logical and well organized, which are seen as relevant guidelines for teaching the student who is at the concrete development stage of 7 to 11 years (Woolfolk, 1998), the age of the students in this projects case study. However, getting the balance of frequent feedback and time for reflection is difficult. Often this time needed for reflection is different for different personality types (Kolb, 1999)

Many teachers when using technology in their classrooms often overlook a lesson that allows time for thinking about and reflecting on content delivered.

*“Paigetian learning researchers hypothesize that there are three routes to knowledge: perceptual, action and conceptual. In each case something the learner has seen, done or thought about creates links with a new situation.” (Jones, 2003)*

A lesson that does not allow the student to experience time for self-exploratory learning is often a missed opportunity for experimentation, reflection and thinking. This is considered a missed deeper learning experience, which many educational researchers (Mackenzie, 2006; Paiget, 2001; Papert, 1993) have identified as a crucial step when scaffolding or increasing knowledge.

Traditional methods of education where the students’ documents are corrected by the teacher and then given back to the student at a later date, often weeks after an event could miss the “in-time” frame for student thinking and reflection to occur. This was highlighted by Ewell (1997) as **“absent reflection”** where the student’s opportunity for cognitive reorganization is reliant on a time to think and reflect within a relevant time span. Effective use of the IWB technology can contribute to the opportunity for reflection and thinking by a variety of functionality. The IWB functionality can model, reverse, classify and seriate objects or ideas in any order or time allocation. Reflection at an appropriate time could contribute to the integration of new ideas with existing knowledge and the construction of a deeper understanding of a situation or observation for a lasting effect.

There is some debate as to whether technology is contributing to short attention spans and a generation of visual learners, promoting and encouraging a preferred learning style. Does the IWB technology contribute to an opportunity for students to jump to a conclusive understanding through the visual literal image, rather than affording a more linear abstract opportunity for a deeper thinking and knowledge attainment (Greenfield, 2003)?

### **3.5.6 Opportunity and equity of IWBs in the classroom**

Because of the inconsistent and wide range of technologies in the classroom, do some students have the opportunity to more effective learning opportunities than others? There has been little

debate on the issue of opportunity and equity as it relates to access for all our students to technology in education. If the New Zealand education system advocates the vision for all students to participate as active and responsible users of technology, fulfilling their potential of becoming effective citizen in society (Ministry of Education, 2006), then there may be a need to review the budgets and requirements that schools are facing today with their ICT implementation.

With all the encouragement and support for ICT in education, there is still inequity in the amount of technology available in New Zealand Primary classrooms. This ranges from schools that have one or two computers in the corner of the classroom, to schools that require the students to own their own laptops as part of their school stationary and are fully integrated digital schools. One such primary school is Mission Heights Junior College, which describes itself as New Zealand's first digital school, offering a wide variety of digital equipment for teaching and learning with little or no textbooks.

Prensky (2008a) argued that it is not important for every student to have the opportunity of experiencing the exact same technology as all other students. All technology has a variety of features and functions, and some of these features are more important to some than to others. More importantly, Prensky noted that what is essential for all students is the need to experience ICT of some sort during their school day.

### **3.5.7 Physical layout of the classroom, environment and health**

Many New Zealand school buildings have been in existence for over 50 years, and some of the classrooms are still in their original form. When considering the implementation of technology, there appears to be little reflection in the way technology is used and the effect that it has on classroom operational spaces. In research into students perceptions of the IWB, educationalists Hall and Higgins (2005) identified the positioning of the IWB at the front of the room, due to inflexible learning spaces, as the reinforcement of a traditional style of teaching.



With the increasing use of technology in the classroom, one issue that does not seem to have been debated to any extent is that of the health risks, both physical and psychological discomfort that is associated when humans interact with technology. This area needs further debate and awareness brought to the attentions of teachers and principals if technology is to be used for long periods within the school day. According to Lai (2005), schools should be developing a health and safety policy related to computer use, outlining the correct posture when working on a computer, ensuring the lighting is appropriate, limiting the time spent on any one task on the computer.

Wireless access and mobile technologies are clearly leading the way of the future in education. In a recent study into the trends and benefits of mobile wireless technology Kim, Mims and Holmes (2006) highlight in their conclusion that the mobile learning environment (m-learning) will continue to grow and be the learning environment of choice for many, particularly in higher education. The IWB technology has the functionality and additional devices to contribute to this mobile learning environment. The IWB suite of remote devices includes handheld slates, voting and texting devices that the children hold and use to interact with the IWB main board from both within and outside of the classroom.

### **3.6 Technology and theory of learning**

It was suggested by Becker (2001) that the effective use of technology was pivotal on the condition that the teacher's fundamental understanding of teaching and learning is based in a constructivist approach, whereby learning is active, cumulative and a goal-oriented process. It could be said that the majority of New Zealand educators have promoted and supported a constructivist approach to teaching and learning, by way of active learning and thinking.

*“The New Zealand Curriculum is a clear statement of what we deem important in education. It takes as its starting point a vision of our young people as lifelong Learners who are confident and creative, connected, and actively involved” (Ministry of Education, 2007, p. 4).*

However, the reality is there are many theories about approaches to how knowledge is gained and information processed. Three key learning paradigms or theoretical models that have been identified are *Behaviorism, Cognitivism and Constructivism*.

### **3.6.1 Behaviorism**

Pavlov, Watson and Skinner have all identified behaviorism as a theory for learning. Behaviorism has been closely aligned with objectivism, which can be explained as focusing on results and outcomes rather than on the thinking and activity of learning that are directly contributed to consequences, behavior and reinforcement of the learner (Siemens, 2006).

In many societies throughout the world, behaviorism is ‘alive and well’. In a behaviorist classroom, the teacher informs the student of the knowledge, and the learner listens, looks and completes the required course work. Depending on the resulting behavior, positive or negative reinforcement consequences will determine whether the learning behavior will be repeated or not. Underpinning this paradigm is the understanding that the learner is a “*clean slate*”, and in order for them to gain knowledge, they are required to understand both the positive and negative aspects of any consequence, which will then allow the learning to produce the right response. The outcome of this is a change in behavior of the student. However, as the behavioral theorists discovered in a collective social environment, the learning behavior and outcomes were not consistent and led the way to the development of a social cognitive theory.

### **3.6.2 Cognitivism**

Because of the identification that learners displayed unexpected behaviors, in the 1960s, a cognitivist revolution emerged. Behavioral psychologists, Piaget, and Bandura identified that behaviorism was too limiting and identified the “*theory of cognitive development for learning*.” They formed the opinion that the opportunity for learning is often affected by others, personal beliefs and thoughts (social cognitive theory) or by the receiver’s stage of brain development and

age in relation to the cycle of learning. These stages of brain development are identified as Preoperational 2-7 years, Concrete 7-11 years, Formal operational 11 – Adult (Woolfolk, 1998).

Cognitive development is when learners can change their behaviors according to their internal knowledge structure and cognitive processes (Piaget, 2001; Papert, 1993). It was the mental process of thinking and problem solving that was contributing to the knowledge gained. To demonstrate this, Marcy Driscoll, Professor of Instructional Systems and Educational Psychology (2000) used the metaphor of the computer. Firstly, you input the data, then encode, store and deliver an output, just like the processing of data into information in the computer. However, the encoding process, which is the active part in how learning takes place, is not consistently reliable, often influenced by an active participation and external factors such as context or environment that all contributed to the construction of knowledge.

### **3.6.3 Constructivism**

Constructivism and situated learning is grounded in the research conducted by pioneering researcher Lev Vygotsky, who identified the “*Zone of Proximal development*”, whereby some tasks are too difficult for a child to learn on their own, but the assistance of an adult or another child, through dialog or active involvement, can scaffold a particular learning opportunity (Vygotsky, 1978). An extension to the cognitive view of learning is the identification that learners construct and interpret their own reality depending on prior knowledge, beliefs, physical and social experiences. Early contributors to constructivism identified that the process of learning is influenced strongly by the involvement of the “active learner”. Here the teacher coaches the learner with encouragement and support, understanding that the learner is actively influenced by past and current experiences, and therefore can contribute to the construction of the knowledge themselves rather than inertly acquire new knowledge.

Current pedagogical practices in New Zealand primary school classrooms are in the main reflective of this constructivist approach to learning. However, both in the classroom and outside of the classroom there is now the influence of technology in the mix, which again contributes to the context in which our students are learning. With the promotion of a student as an active

learner and influence of ICT on the teaching and student roles, there is a need for further research into a new learning theory, suitable for our 21<sup>st</sup> century connected learner.

### **3.6.4 Connectivism – a new paradigm for teaching with technology**

The learning theories above (Behaviorism, Cognitivism and Constructivism) were developed when technology did not have a significant presence in the classroom. In considering the effect of technology in the classroom, where it can be used to communicate, access information and organize content, it could be stated that there is a long overdue need to identify a learning theory for the digital age.

Generations Y and Z are terms for people born after 1984. These generations have been classified by Prensky (2001) as “***Digital Natives***” and widely identified in research as students who have been born into and are totally immersed in an environment that is surrounded by technology. This has raised the question “*are today’s learners and the technological tools they use indicative of a new way in which students acquire knowledge?*” As discussed by Cathy Gonzalez, when previous generations completed their schooling, the knowledge that they had was generally thought adequate to enter their careers, and extra training was usually limited or at the discretion of the employer. This is not the case today. Students in school today are required to become skilled in information acquisition, skills which they will continually use throughout their careers and lives. Today, the time span to gain the required knowledge for a specific career is not restricted just to schooling years as explained by Gonzalez (2004).

***“The “half-life of knowledge” is the time span from when knowledge is gained to when it becomes obsolete. Half of what is known today was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). To combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction”(Gonzalez, 2004, para 1).***

With access to the internet 24/7 and a global knowledge base, students are identified by Siemens (2004) as connected learners. Siemens summarized learning as a dynamic activity, where the student taps into the knowledge on a need-by-need basis. Technology provides a variety of useful information gathering tools, such as search engines, readers and social networking, whereby learners have access to vast amounts of information and opportunities to participate in conversations with others. With technology, we do not require knowledge to reside solely and conclusively in the recipient's mind for any length of time. But what is needed are skills to find information, make connections, recognize patterns, make comparisons and identify the relevance when needed (Siemens, 2004). The following table (Figure 4-3) from Siemens (2006) outlines the comparisons between the learning theories, Behaviorism, Cognitivism, Constructivism and Connectivism and advocates the need for a new paradigm for learning in the 21st century.

<b>Property</b>	<b>Behaviorism</b>	<b>Cognitivism</b>	<b>Constructivism</b>	<b>Connectivism</b>
<b>How learning occurs</b>	Black box—observable behavior main focus	Structured, computational	Social, meaning created by each learner (personal)	Distributed within a network, social, technologically enhanced, recognizing and interpreting patterns
<b>Influencing factors</b>	Nature of reward, punishment, stimuli	Existing schema, previous experiences	Engagement, participation, social, cultural	Diversity of network, strength of ties
<b>Role of memory</b>	Memory is the hardwiring of repeated experiences—where reward and punishment are most influential	Encoding, storage, retrieval	Prior knowledge remixed to current context	Adaptive patterns, representative of current state, existing in networks
<b>How transfer occurs</b>	Stimulus, response	Duplicating knowledge constructs of “knower”	Socialization	Connecting to (adding) nodes
<b>Types of learning</b>	Best explained Task based learning	Reasoning, clear objectives, problem solving	Social, vague (“ill defined”)	Complex learning, rapid changing core, diverse

**Figure 3-3 Learning Theories (Siemens, 2006)**

This understanding that there has been a change from a formal text-based knowledge to a knowledge that is gained by the identification of patterns and a variety of collaborative learning opportunities is the driver for forming a new learning theory. Digital technology is ubiquitous and for many children in New Zealand schools when using the IWBs in the classroom, the technology is embedded and transparent allowing for access and experience to vast amounts of information, from many different sources. The teacher's role has changed with this scenario. They now become the learning designer, who co-constructs the learning network alongside the learner so they can access, build, and create knowledge together.

In this case study project, when the researcher observed classes using the IWB, close attention was given to identifying the type of learning theory that appeared to be underpinning the lesson structure. In addition, interview questions were asked to clarify teachers' attitudes and opinions on the learning theory that they most align their teaching and classroom strategies with. It could be suggested that without this understanding that technology is dictating a change in the way teaching and learning is constructed, technology could fail to contribute effective learning opportunities.

### ***3.7 Chapter Summary***

The literature review positioned this project in context by reviewing the history of ICT in New Zealand schools, and the effects on the education sector, both teachers and students, when using technology and in particular IWB technology. Although there is limited current research here in New Zealand, a number of researchers have been recently active in this area in the UK.

A number of aspects have been reviewed surrounding the IWB technology. Research on the effects on the teaching role, student role and classroom have been reviewed to establish the contributions to teaching and learning. The functionality of the technology has been reviewed to pick the areas of use that best contribute to student learning.

Then when considering how to assess and analyze effective learning opportunities with technology, the researcher reviewed the main three learning theories, behaviorism, cognitivism

and constructivism. The literature also identified new learning paradigm currently being debated in education; called connectivism. Connectivism reviews the theory of learning when technology is part of the learning landscape. Understanding the various opinions on how we learn and effective learning theories will help identify teaching strategies and effective learning opportunities when observing the IWB being used in the classroom as a teaching tool.

The following points have been identified as gap in the literature that will be addressed in this research project:

- Addressing the question, does the use of the IWB as a resource in the classroom contribute to the argument that there is a need for a new learning theory paradigm for the digital age?
- Answering the call for more empirical evidence in the use of the IWB technology in the classroom in New Zealand schools.

Could the IWB technology contribute to the identification of an effective learning approach and the opportunity to engage students of today or alternatively, is it contributing to a passive fun, sensory overload experience that is altering our intellect to select only short bytes of information and not allowing a deeper linear learning opportunity? This empirical research project intends to go beyond the observations of the pupils and teachers when using the IWB and endeavor to understand the processes of teaching with the IWB and its connection to learning.

In the next chapter the research methodology, research planning and data collection, and the triangulation of data that will support the validity of the data analysis are presented.

## **Chapter 4      The Research Project Methodology**

### **4.1 Introduction**

This research project is a case study, using qualitative questioning methods of “why, how, what, when and where”, to examine the use of IWB technology as a teaching and learning resource in the classroom. It is an in-depth examination of a single New Zealand Primary school over a period of four school terms from July 2008 to August 2009 (13 months). A case study methodology was chosen to answer the main research question:

*What are the factors involved in contributing to effective student learning when using interactive whiteboards?*

This case study project was a way of researching a contemporary real-life situation where the IWB technology was being used as a resource for teaching and learning. Additionally, this project was a response to a call from stakeholders in education (Gernhoefer, 2009) and educational researchers (Beauchamp & Parkinson, 2005; Smith, et al., 2005) for more in-depth examination into the empirical research in how the IWB technology in particular can contribute to effective teaching and learning. This project goes beyond an intuitive understanding of the contribution IWBs may be having on engaging the student, to a more contextual empirical study on the actual use of the IWB technology and its impact on the previously identified ways in which students learn (Siemens, 2006 – see Figure 4-3 above).

### **4.2 Overview of Case Study school**

The following statistics have contributed to forming the case environment, in which the research project has been conducted.

#### **4.2.1 Case Study Demographics**

The case study school is a government funded state school and caters for 510 students aged 5 to 11. Staff include; 1 Principal, 2 Associate Principals, 23 Teaching staff, 4 Administration persons, 3 Teacher Aids and 1 property manager. At the time this project was conducted the



school was near its maximum intake with a roll of 506 students. The school gender mix is 52% girls and 48% boys. The ethnic composition is overwhelmingly NZ European/Pakeha at 82% with Maori, British, Pacific and other ethnicities making up the remainder. The Ministry of Education has classified this school as decile 10. Decile rating is a measurement calculated from the general census conducted by Statistics NZ every five years and based on the following factors: household income, occupation, household crowding, educational qualifications and income support. It gives a broad range of the aggregated socio-economic position of the parents of the students. Decile 10 is the highest rating obtainable.

#### **4.2.2 ICT Capability and strategy within the school**

The school has a local area cabled network with broadband internet access throughout all classrooms and administration offices. The classrooms are fitted with up to three networked computers and a printer. The majority of teachers, with the exception of two, use a laptop for class administration. The computer suite/POD has 16 networked computers and a data projector. This suite is booked on a session basis. Most classes have computer pod time scheduled into their class timetable. A current addition to the ICT infrastructure is the integration of a trial digital classroom. This classroom is fitted with 12 laptops, and about 50% of the daily student learning experiences are carried out on the laptops, and other digital devices such as cameras.

At the start of the research project in 2008, the school had seven Promethean Activboards in their school - one mobile board and six fixed boards. At the end of the data gathering (13 months later in 2009) they had purchased three more fixed Promethean Activboards, to total 10 IWBs. The school does not have any personal handheld response units yet, although staff are eager to get some as soon as possible.

While there is no formal documented ICT strategy, the school is implementing a number of ICT plans and supports the use of ICT to supplement and support traditional ways of teaching where the teacher thinks appropriate. The school has an extensive website, incorporating an e-learning zone for students to use after school hours. This zone has literacy, mathematics and other interactive educational games available. A number of the senior classes also keep student blogs

on the school website, commenting on current classroom activities to which many of the parents contribute.

#### **4.2.3 Curriculum learning areas covered in this research**

The case study schools' curriculum learning areas follow the New Zealand Primary school curriculum as outlined below:

- **“English** – students study, use and enjoy language and literature communicated orally, visually or in writing
- **Health and Physical Education** – students learn about their own well-being, and that of others and society, in health-related and movement contexts
- **Learning Languages** – students learn to communicate in an additional language, develop their capacity to learn further languages and explore different worldviews in relation to their own. (The school has included New Zealand's other office language – Te-Reo)
- **Mathematics and Statistics** – students explore relationships in quantities, space, and data and learn to express these relationships in ways that help them to make sense of the world around them
- **Sciences** – students explore how both the natural physical world and science itself work so that they can participate as critical, informed and responsible citizens in society in which science plays a significant role.
- **Social Sciences** – students explore how societies work and how they themselves can participate and take action as critical, informed and responsible citizens
- **Technology** – students learn to be innovative developers of products and systems and discerning consumers who will make a difference in the world
- **The Arts** – students explore, refine, and communicate ideas as they connect thinking, imagination, senses and feelings to create works and respond to works of others”

**(Ministry of Education, 2007)**

Although classes have the learning areas identified in their daily activities, the school leaders have mapped the curriculum to the way in which they wish to teach the learning areas. The

mapping aligns with the suggested evidence-based practices outlined by the Ministry of Education(2007).

#### **4.2.4 Case study school and e-maturity**

The adoption of ICT by leadership and management is seen as an essential strategic requirement. In research conducted by Grainger and Tolhurst (2005) into the factors that affect the uptake of ICT by teachers, it was made clear that some school principals are not involved in the implementation or supportive of ICT in the classroom. More often than not, ICT planning and strategic decisions have been left to a teacher or teachers who show awareness or have a personal interest in using ICT in their classroom. This lack of involvement from school leaders is seen as a contributing factor to a lack of e-maturity, progression of ICT within a school. The case study school in this research has seen a significant increase in the use and acceptance of technology since a change in school leadership in late 2007. The new principal and associate principal are both supportive and modelers of the use of technology.

As identified by Fluck (2003) the practical issues associated with ICT, such as the lack of time associated with the planning, preparation and implementation of ICT into an already overcrowded curriculum, coupled with the change in lesson structure and pedagogy can lead to many teachers not prioritizing the need for ICT in the classroom. To address some of these issues, the case study school in this research has participated in the Information and Communication Technology Professional Development (ICTPD) cluster program since 2007 (see Section 3.4.3). For the case study school, initial planning for the participation in the ICTPD cluster program required a needs analysis to be conducted with intended participants. From this analysis a series of staff development courses were identified to increase the ICT skill levels amongst staff.

However, up-skilling was not the only outcome of the program, a shift in attitudes and opinions towards ICT was seen in the school, due also to the Laptops for Principals and Teachers program (see Section 3.4.2). The following is an example collected from the interview data that supports this change in maturity towards the use of ICT in the case study school.

*“[in the ICTPD program] we were able indicate what we needed to know, and we were able to run little PD sessions, but another thing I feel bought on the ICT is the Teachers for Laptops initiative. It started with just the senior teachers, then they [principal] realized how it was impacting, so they got the junior teachers their own laptop and it’s made them use it more, and want to do more with ICT” (Teacher 1, personal communication, July 23, 2008).*

A recent upgrade to the school’s computer suite/POD, a dedicated ICT classroom for specialized computer lessons, has contributed to the ICT infrastructure maturity of the school. This is illustrated by the comment from the case study participant below:

*“When we had the old computers you could go into that pod at any time because nobody ever wanted to be in there. The machines froze, they crashed, it was a nightmare. Now with the new computers and the data projector you have to book, you are lucky if you can get in there. Now I prepare what we [the students] are going to do before we go in there and basically use it for research or maybe publishing something” (Teacher 1, personal communication, July 23, 2008)*

Each case study participant in this research was unanimous in the opinion that although there was some time taken in familiarizing and implementing the IWB into their lesson plans, they all agreed that the resulting teaching structure was more streamlined once this initial familiarization was completed.

#### **4.3 Justification on selecting a case study for this research project**

The research project’s primary objective was to examine a contemporary phenomenon that is currently being experienced by many New Zealand Primary schools. A case study was selected so that the researcher could holistically examine the event, which was the use of the IWB in the classroom in real life situations. This close examination of the human experience, observing both the students and teachers, was supported by interviewing school leaders and teaching participants. As discussed by Stake (2005), for many professions a case is defined by a concern,

for example a patient is referred to as a case by a doctor or social worker, but the methods in data collection and analysis of that patient can be both qualitative and quantitative.

The data collected in this case study contributed to an *interpretive research output* that investigated genuine experiences, activities and patterns, over a series of classroom observations. Supporting the observations, the researcher conducted interviews that focused on the teaching participants' approach to ICT; their attitudes, opinions, and in particular the use of the IWB technology and its contribution to teaching and learning. In justification for this case study sampling method, there was a clear mandate that this project was not to undertake a comparison of the use of the IWB over many schools, but was specifically concerned with the detailed investigation of a particular school and its use of the IWB. The intended outcome was to be descriptive and seek to record a genuine experience.

As the researcher is known to the school as a parent helper, who often is in the classroom as an aid, on school trips and as a regular supporter of the reading program, it was thought that the researcher would be considered as an internal researcher. This familiarity with the school administrators and teaching staff was thought to be invaluable to the rapport already present between the case study participants and researcher. Additional to this rapport, was the long-term opportunity for the researcher to consistently reflect on the practice and use of technology, and the e-maturity of the school over the years (six years) of involvement in the school. As discussed by Stake (2005), continual reflective practice by the researcher is critical in qualitative casework, for relating the observations to meanings within contexts. In effect, the researcher has managed to pilot and pretest this research project, by way of being present as a classroom helper in a number of classes that have used the IWB technology during the lesson.

The research project did not focus on the assessment outcomes of the students after a lesson conducted with the IWB, but rather concentrated on the lesson structure and IWB contribution to student learning during the lesson. This research was **not** an *Intervention study*, and did not involve action or participation by the researcher during the observation data collection. Careful consideration and ethical principles were maintained during the observation process. As young children (ages 7-10) were under scrutiny, there was no interaction between the students and the

researcher whilst carrying out the project (see Section 4.6). As discussed by Collecute, Douglas, Mardle and Fielden (2006) research projects could result in a direct reflection on the student's education, with consequences, therefore it was deemed appropriate that this ethical consideration was identified to the school as part of the initial research planning.

#### ***4.4 Research planning and data collection***

Early in 2008, an initial approach to the principal of the school to conduct the research was successful. The project was discussed at length with the principal, and permission to conduct the research from the Board of Trustees was accepted. The principal identified and informally approached four of their teaching staff that currently had IWBs in their classrooms to become observation and interview participants in the project. The researcher formally approached the teaching participants by letter (see Appendix 2). Four teachers confirmed their consent to participate in the research, two from Year 4 (students aged 7 to 8) and two from Year 5 (students aged 9 to 10).

During the project, two of the selected four teachers became pregnant and advised the researcher of their maternity leave. It was expected that the data collection would be finished in time before they went on maternity leave, but this did not happen, due to the participants' teaching schedules and commitments. This was a contributing factor in the delay of the data collection phase. After the two participants left for maternity leave, the principal suggested two additional teachers as replacement participants, and a new round of interviews and observations were conducted.

##### **4.4.1 Steps outlining the research-planning schedule:**

1. A letter of introduction (see Appendix 2) with a consent form (see Appendix 3) was sent to all participants. An opportunity was given to the participants to discuss the research project individually with the researcher before agreeing to participate.

2. Consent forms were signed by participants and a timetable was organized with each participant for interviews and observations that would fit in with their schedules.
3. Pre-observation interviews with the principal, associate principal and teachers were conducted. The school employed a relieving teacher for a day so that the researcher could conduct interviews consecutively over one day. All interviews were digitally recorded, and transcribed.
4. Observations of classes were undertaken over four terms (13 months) within the school. The researcher sat at the back of the class with no interaction with teacher, students or lesson and observed the interaction with the teacher, students and IWB technology. Whilst observing classes, the researcher recorded field notes on the experience on paper (see Appendix 1c). In particular, the structure of lesson was recorded with the IWB as the lesson resource, the interaction between the teacher and the students, the students and other students, the teacher and students with the technology, the atmosphere of the environment, successes and challenges and any reflections that the research observed.
5. Follow up interviews with leaders and teachers were then conducted later at a convenient time to the participant. The intention of this interview was to clarify any questions that the researcher noted during the class observations, the lesson outcomes, success and challenges as well as gaining further opinions on the participant's use of the IWB and its contribution to student learning.
6. Relevant school documents were made available to the researcher. School policies and lesson plans were reviewed to help identify existing ICT strategies and the use of ICT within the school.

Pre-observation and post-observation interviews with the school leaders and teachers were conducted in a relaxed and informal manner. A number of demographic and open questions were asked to identify the participants' understanding and attitude to ICT in education. All interviews were recorded on a digital recorder for transcription later. The researcher altered

the questions concerning the position held in the school of the participant. Changes are as follows:

- One interview with each of the Principal and Associate Principal to identify the vision and strategy towards ICT and IWB in the school (see Appendix 1a)
- Pre-observation interviews with teachers, to gather their opinions and attitudes towards ICT, and in particular the IWB technology and its affect on teaching and learning (see Appendix 1b)
- Post-observation interviews with teachers, carried out to gather opinions from the teachers on how they thought the teaching and learning went with the IWB technology. Because this interview was conducted often some time after the observation, the research sought to record any changed perspectives and opinions on the IWB technology for teaching and learning (see Appendix 1d).

#### ***4.5 Data Set collection Procedures***

The case study data collection methods consisted primarily of classroom observations, pre-observation, and post-observation interviews with teaching staff and management. Further data was collated from school policies strategies (on the school website) and lesson plans for the observed classes made available to the researcher.

##### **4.5.1 Data set collected in pre observation interviews**

All interviews were undertaken in a private room, in only the researcher and the interviewee present. All interviews were recorded on a digital recording device for transcription later.

The protocol for the interview process was consistent in every interview, where the same questions were asked of all participants, except when the interview changed between management and teachers, when the questions were reflected to the role within the school of the participant.

For all participants, the interview started with a number of demographic data questions:



- What is your role within the school and teaching involvement?
- Where did you do your teacher training and how long have you been teaching?
- What is your personal ICT experience and have you had any ICT professional development?

Open questions were then used as prompts to elicit the following information (see Appendix 1a & 1b)

- Opinions on the ICT in the classroom
- Opinions on their lessons undertaken with the IWB technology
- Opinions on the IWB and its relevance to teaching and learning
- Opinions on teaching and learning with technology

Because of the data obtained from the open questions and the conversational nature of the interview, the interview did follow and flow in other directions as alternative and unidentified topics and themes arose.

#### **4.5.2 Data set collected from classroom observations**

Data gathered from the class observations were recorded as field notes (see Appendix 1c). The protocol for recording the observed lesson was to use the same field notes outline within every observed lesson to create a consistent range of data for analysis, comparison and contrast. The field notes document format recorded both descriptive and (the researcher's own) reflective notes. At the beginning of each observation, descriptive demographic and lesson structure information was recorded as follows:

- Dates, teaching staff, numbers of students
- Lesson topic, context
- Technology used

Then the lesson from start to finish was recorded in detail as follows:

- Lesson structure and activities

- IWB functionality used
- Examples of student reactions and outcomes
- Examples of perceived effective learning opportunities with the IWB
- Examples of teaching pedagogy and classroom management
- Notes on the physical classroom environment.

#### **4.5.3 Data set collected in post observation interviews with teachers**

Whilst the post interview was intended to follow the lesson observation, in reality this did not happen. Due to the participants' schedules, the post interviews were delayed with some post interviews carried out the next semester. A number of pre-identified themes identified from the pre-observation interviews were followed up in the post-observation interview. The post-observation interview questions followed the following themes:

- What changes have there been in your experiences with the IWB since the pre interview?
- What other aspects of the IWB besides engagement and motivation do you think are contributing to effective student learning?
- What is your understanding of the required pedagogy that should underpin the use of the IWB in the learning process?
- What is your opinion on how the IWB has influenced the classroom environment?

#### **4.5.4 Data set collected in post observation interviews with management**

Post interviews with the school management were undertaken 12 months after the initial interviews (see Appendix 1e). Topics identified in the initial interviews were developed further and the researcher was keen to see if there had been any change to the ICT strategy one year down the track. Conversation themes were as follows:

- Changes in the school with regards to the IWB technology use
- Changes in the school curriculum and ICT strategies
- Opinions on the effects of these changes on teaching and learning
- Opinions of the future of ICT in the school

#### **4.5.5 Difficulties in data set collection**

The main difficulty experienced during the data collection period was coordinating the observations and interviews into the leaders' and teachers' professional schedules. Leaders and teachers of schools have a full and busy day so rather than taking the expected two semesters (half a year) to collect the data, collection took place over a 13 month period.

The schedule was compromised further as two of the teachers who had initially committed to the research project became pregnant and took maternity leave. The pre-observation interviews and all the observations had been done by the time those participants took maternity leave, but post interviews were not conducted with them. However, two new teachers were approached and consented to be part of the project, therefore the data sample increased through a further round of class observations and interviews. The total number of teaching participants in the project had now increased to six.

#### **4.6 *Ethical considerations when collecting the Data***

In the initial stages of research planning and proposal, the Board of Postgraduate Studies at UNITEC was advised of the intention of this study and the desired ethical approval was requested. As human subjects, both adults (interviews) and children (observations), were involved as participants in this research so ethics approval was required. The identity of participants was known to the researcher, so every endeavor was taken to protect and ensure their anonymity throughout the entire research project and the creation of the thesis.

Each adult participant was given an introductory letter and information sheet (see Appendix 2) outlining the intention of the research and a brief outline of the research plan. Also included was a consent form (see Appendix 3) highlighting the confidentiality clause of complete anonymity of the participant and school, the protection of the data gathered, and clarifying the options of withdrawal from the project at any time.

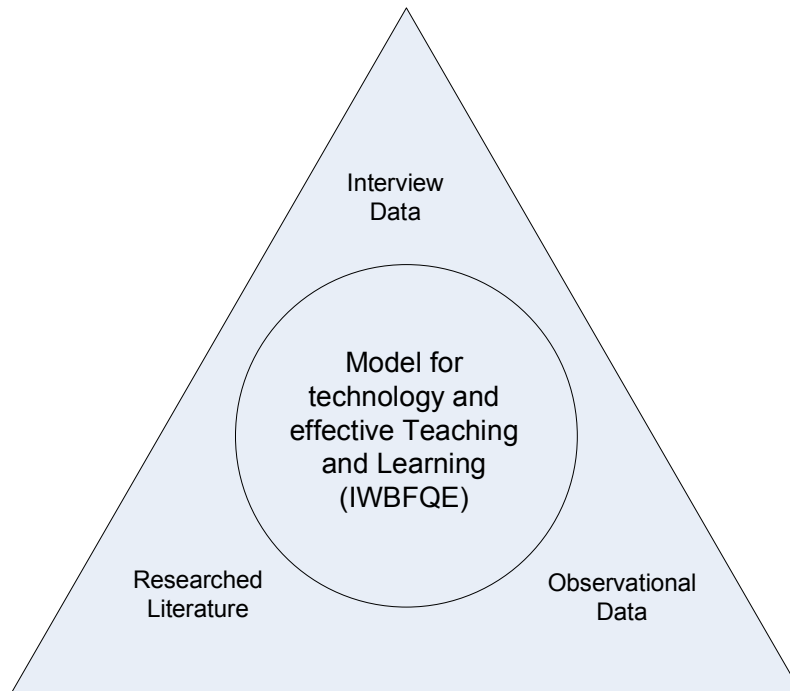
Students were not interviewed by, and did not interact with, the researcher at any time during this project. Due to the ages of the students and ethical concerns surrounding the research as a Case

study, it was of utmost importance that their identity remained anonymous throughout the project. This requirement was set by UNITEC Research Ethics Committee prior to the project beginning. To protect the students' anonymity in the project, the researcher made it clear to the teaching participants that her intention was not to interact with the students during the observation and to be as unobtrusive in the classroom environment as possible.

#### ***4.7 Checks for validity and reliability of data collected***

Because of the qualitative nature of this case study research project, the biggest threat to the validity of the data was the opportunity for generalization when observing the classroom lessons. In order to ensure the credibility of the data collected and trustworthiness of the analytical outcomes the data were triangulated with other forms of data.

The data collected from interviews and observations were triangulated with current published research, and underpinned by a model designed for the facilitation of effective learning with technology (see Figure 4-1 below). This triangulation of the data was carried out repeatedly throughout the research project to ensure the researcher's interpretation was valid. Further, authenticity was increased with the inclusion and support of the participants' interview data when compared and contrasted against the observational data. The following model shows this triangulation of data.



**Figure 4-1 Triangulation of data to ensure credibility and trustworthiness of the data collected. (Researcher's own model)**

Another threat to the outcomes of the research was the opportunity for erroneous presumptions or bias by the researcher. To combat this, the researcher identified this possibility and continually analyzed the data collected to check and balance the analysis with current published literature as discussed in the Literature review in Section 3. The researcher has also reported both confirming and discrepant information uncovered over a significant period of time (13 months), that this contemporary real life examination revealed.

#### ***4.8 Theoretical frameworks used for data analysis***

The original research questions that formed this project are:

- **How is the IWB technology being used to maximize learning opportunities for students?**
- **How is the IWB technology contributing to effective teaching and classroom strategies to support student learning?**

- **How has the introduction of IWBs in the classroom changed the physical learning environment for the teacher and student?**

Central to all three questions is the contribution that the IWB has on student learning. In order for the data to be consistently examined, we must identify “*what is effective learning*” and then map the relative theoretical frameworks used in this research to identify a deeper learning opportunity.

#### **4.8.1 How do we define effective learning?**

If effective learning can be seen as the opportunity to deepen your understanding of a topic or concept then the following definition by educational technology researchers Finger, McGlasson and Finger (2007) states that deep learning is as a combination of a deep understanding and deep knowledge:

*“Students develop deep understanding when they grasp the relatively complex relationships between the central concepts of a topic. Instead of being able to recite only fragmented pieces of information they understand the topic in a relatively systematic integrated or holistic way... Knowledge is deep when it concerns the central ideas of a topic or discipline judged to be crucial to it. Deep knowledge involves establishing relatively complex connections to those central concepts.” (Finger, et al., 2007, p. 1049)*

If the student is able to understand the connections, reflect and reconstruct conclusions or present arguments around the central ideas of topic, then the deep knowledge and more effective learning has taken place (Finger, et al., 2007). The research will look closely at identifying the IWB functionality that can contribute technically to increasing a deep understanding and knowledge of a topic. The IWB functionality gives students the opportunity to interact with a topic using a variety of multimedia, repeatedly, seamlessly and in what has already been established in the literature as technology which engages students in the classroom (Beauchamp & Parkinson, 2005; Hall & Higgins, 2005).

## **4.8.2 Theoretical tools used to measure effective learning with the IWB**

With the wide and varied factors that surround the act of learning, there is no clear and evidential way to conclude that technology has contributed to an increase in learning and attainment of knowledge. However, in this research project, contributing factors were identified that may result in effective learning when the functionality of the interactive whiteboard is being used effectively.

The following teaching and learning frameworks and models were used to compare the data collected and its relevance to effective learning opportunities.

### **4.8.2.1 Framework/Model to Measure Effective Learning with the IWB**

Whilst there have been many who have documented and established theories on the best way children think and attain knowledge (Piaget, 1962; Papert, 1993; Vygotsky, 1978), there has been no complete scientific measurement of effective learning factors established. However, many factors have been identified as legitimate contributors to learning. In particular, if lessons are conducive to particular personality type patterns and preferred learning styles and are suitable to the cognitive stages of development, then these are factors that have all been identified as conducive learning conditions (Honey & Mumford, 2000; Myers, 1995; Woolfolk, 1998).

### **4.8.2.2 Models for Learning Style and personality perspectives**

Many teachers are familiar with the identification of a student's personality type and the effect on a preferred learning styles. It was suggested that if teachers were informed about the variations of learning styles that students preferred within their class, they could tailor their teaching methods, contexts and techniques, to the various learning styles so that the student would have a better opportunity to learn (Honey & Mumford, 2000).

Additionally, identifying a learner's personality type was considered an underlying factor of the learners' preferred learning style. Myers Briggs Type Indicator (MBTI), an extension of Jung's

personality model (Jung, 1933) identifies the personality dimensions of **Extroversion** or **Introversion**, **Sensing** or **Intuition**, **Thinking** or **Feeling**, and **Judging** or **Perceiving** as underpinning a favored learning style (Myers, 1995). From the learner's perspective, the preferred learning style is the most comfortable way in which they learn, in terms of their ideal environment, instruction mode or activity type when engaging in learning. Whilst there have been many learning style models identified, the following two models are based on the Myers Briggs Type Indicator (MBTI) and are commonly quoted in business and education:

- “**Kolb’s Learning cycle model** identifies the learners preferred style as **Concrete experience**, feeling and sensitive, **Reflective observation**, watching and before judging, **Abstract conceptualization**, thinking and logical analysis, **Active experimentation**, doing, taking action including risk taking” (Kolb, 1999, 2009)

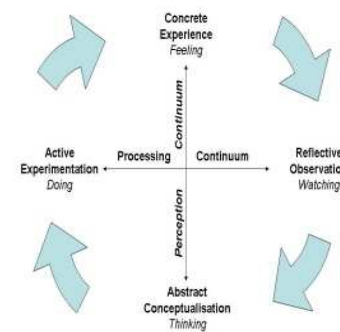


Figure 4-2 Kolb's Learning cycle model (Kolb, 2009)

- “**Honey and Mumford’s Learning cycle** categorizes learners by the way in which they prefer to learn. **Activists** who prefer hands on work, problem based learning, or new experiences and involvement with others. **Reflectors** who prefer watching, thinking, and reflecting on what has happen before taking action. **Theorists** who like to think through problems, proceed step-by-step using models and analogies. And lastly, the **Pragmatist** who learns best by applying new information to a real life practice” (Honey & Mumford, 2000, 2009).

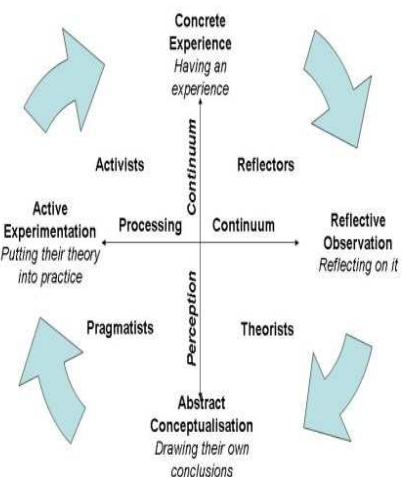


Figure 4-3 Honey and Mumford's Learning cycle model (Honey & Mumford, 2009)



While many people can identify their own preferred learning style, it has been argued that this preferred style is not the only way that that person can obtain knowledge. In her information literacy handbook, educational psychologist Dr Joan Kaplowitz (2008) suggested if a lesson presents a variety of learning style methods, the learner has an opportunity to go beyond their preferred learning style, experience an alternative to their preferred option and therefore become comfortable in a variety of learning opportunities for the future. However, adding to the debate, there have been some criticisms of learning style theories (Coffield, Moseley, Hall, & Ecclestone, 2004; Smith, 2001) mainly in the lack of sound empirical research, inadequate validation and lack of identification of the contribution that cultural influence and experiences have on the choice of learning styles.

In this case study, participants in this research project have identified that the IWB technology offers the opportunity to appeal to different students' learning styles in the classroom.

***“I know when I have taught things in the past children have struggled with certain things like fractions. Fractions are one thing that children find quite difficult whereas now you have so many other ways of teaching it, videos to show them, flipcharts, so there are many different ways to take the children, more tools now. They all do have different learning styles which the IWB can help” (Teacher 2, personal communication, July 23, 2008).***

The Case study participants have identified that the IWB offered a variety of instructional resource approaches applicable for a mix of learning style perspectives, opportunities for interactive (Activists), multimedia (Reflectors & Theorists) and co-construction (Pragmatists) therefore the Honey and Mumford preferred learning style model (Honey & Mumford, 2000) will be used in the analysis of the data collected in this case study.

#### 4.8.2.3 Model of cognitive learning stages and development

Like preferred learning style theories, ensuring the topics and the way we present knowledge to students are suitable for their stage of development is thought to be an important factor in effective learning. Educational psychologists have maintained that the thinking and brain development of a child can be measured in stages according to their age. Swiss psychologist Jean Piaget identified *the stages of cognitive development* (Woolfolk, 1998) as Sensorimotor (0-2 years), Preoperational (2-7 years), Concrete operational (7-11 years) and Formal operational (11-adult years). As the students observed in this research project fall into the concrete operational development age (7-11 years), it is important to consider their suggested stage of development and the way in which the IWB functionality is conducive to their opportunities for learning.

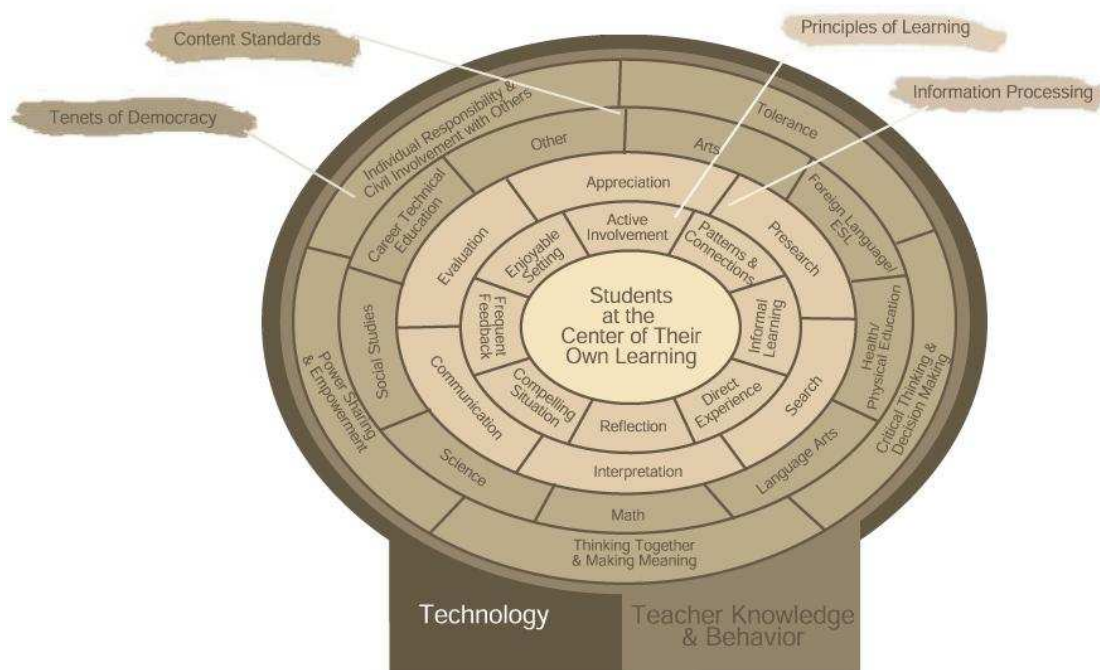
In general, students at this *concrete stage of development* have moved on from having difficulties in seeing others points of view (Preoperational 2-7) and are starting to think in a rational fashion. The maturation and brain development for students of their age is that of a “hands on” and logical thinker with regard to their physical world. These students should be able to classify, seriate and reverse information available to them (Woolfolk, 1998). The IWB functionality is clearly an opportunity for this age group, as it affords the opportunity to visually collate symbols (classify), examine effects and test scenarios (seriate) and then repeat (reverse) the material being taught in a seamless manner without loss of continuity.

However, it has been identified that for students in the concrete development stage, difficulties arise when they are required to solve abstract or scientific problems without placing the work in a real life context (Woolfolk, 1998). These skills have been identified as the next stage of development, more likely for 11 years old to adult (Formal operational). However, this may not be so if technology is used as a tool for abstract or scientific problems. Schuck and Kearney (2008) carried out research into the use of two technologies; Digital Video and IWB technology and their influence on pedagogy. They discuss in their findings that both technologies enhance conceptual development in students when the technology is used at a crucial stage in learning, where ideas and views can be exchanged with others.

#### **4.8.2.4 Models for assessing technology in effective learning and information processing**

In the haste to incorporate technology into the school environment, opportunities to evaluate the learning outcomes for students when using technology are not often prioritized. Educationalists William Callahan and Thomas Switzer (2004) identify the University of Northern Iowa's model *Technology as facilitator of Quality Education (TFQE)* as a theoretical framework for teachers to diagnose the technology they are using in the classroom with regards to its contribution to effective learning opportunities. The model (see figure 4-4 below) shows seven dimensions: *students at the centre of their own learning, principles of learning, information processing, content standards, tenets of democracy, and the encompassing technology and teaching knowledge and behavior*. The authors argue that opportunities where all dimensions are represented contribute to quality education (Callahan & Switzer, 2004).

For the purpose of this research project, only the first three dimensions will be considered and used for the analysis of the data collected. They are *students at the centre of their own learning, principles of learning and information processing*. The first layer surrounding the centre dimension, *students at the centre of their own learning*, and the *Principles of Learning* draw heavily on the work of educationalist Peter Ewell (1997) for his work on identifying what principles are necessary for prime opportunities for learning. The second layer, *Information Processing* contributes to the work of Marjorie Pappas and Ann Tepe (1997) on information processing in a digital age.



**Figure 4-4 Technology as a Facilitator of Quality Education (TFQE) Model developed by Callahan and Switzer, University of Northern Iowa**

At the core of this model is the student, who if at the *centre of his or her own learning* is in control of their learning. This control is seen as a process, essential to the student moving from a passive recipient of information to an engaged learner. An engaged learner is seen as a motivated and in control learner.

For the purpose of this research project, which is concerned with effective student learning when using the IWB technology, only the two immediate layers adjacent to the core, that of the *Principles of Learning layer and Information Processing layer* are considered. Because of this reduction from the original model, the following model below (see Figure 4-5) is a modification of the **TFQE model**, and is named as the **Interactive Whiteboards as a Facilitator of Quality Education (IWBFQE)** by the researcher. This modified version will be used in the following data analysis, for diagnosing the IWB technology and its effectiveness in contributing to effective student learning.

#### 4.8.2.5 Interactive Whiteboards as a Facilitator of Quality Education (IWBFQE)

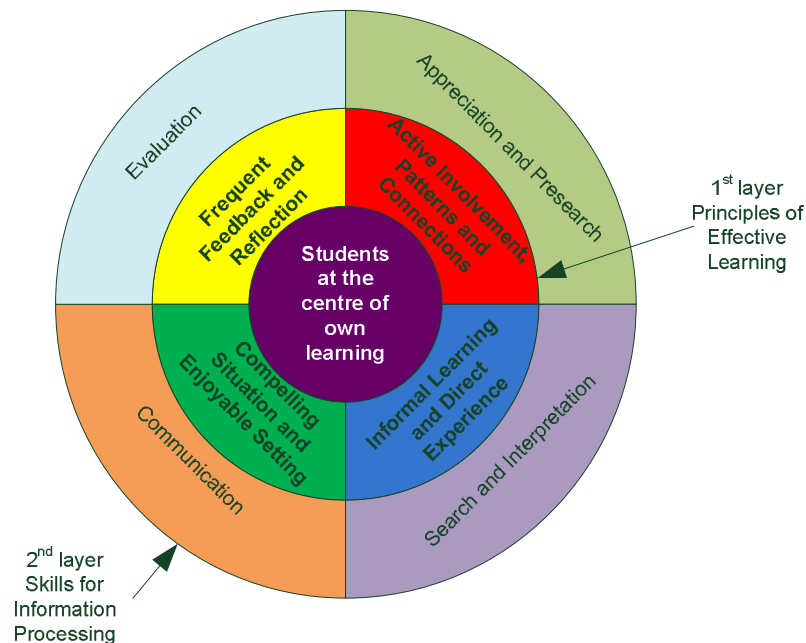


Figure 4-5 Model of Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)

Although many in the education sector have recognized the key to engaging and motivating a student is to allow the students to be at the core of their own learning, this concept has been misunderstood by many others. Student-centered learning does not mean the student is learning on their own, by themselves in an isolated environment. It is quite the opposite in fact. In the most part, a student at the centre of their own learning requires support, understanding and good classroom management if they are to develop the skills for effective learning.

*“Student centered learning is when the student becomes an active participant in their learning rather than a passive recipient; students are more intrinsically than extrinsically motivated; learning is more individual than standardized. Student*

*directed learning (SDL) develops learning how to learn skills such as problem solving, critical thinking and reflective thinking” (Callahan & Switzer, 2003).*

Depending on the cognitive developmental stage and previous schooling experiences, many primary school students are unfamiliar and unpracticed with self-discipline and time management skills. Both skills are fundamental to students directing their own learning. It takes time and effort for the teacher to develop these skills with the students. Educational psychologist Anita Woolfolk (1998) advised that the combination of motivation and self control will contribute to students learning independently throughout life. These are not easily obtainable concepts for young students to understand. It requires a certain maturity development in the student, which the IWB technology may be able to contribute to, through increasing the opportunities for engagement and interactivity.

This identification of real and relevant experiences can engage and stimulate students to think and build on their existing knowledge. Educational researcher (Riel, 2003) identified that when students drive their own learning, building on their own levels of understanding, choosing their own learning direction and goals in a well managed environment, they will undertake a deeper and wider learning experience. Additionally if there is an opportunity to capitalize on students’ personal interests, there may be an opportunity to advance their current understanding, and in turn result in more original and richer learning outcomes.

When carrying out the following data analysis, the IWBFQE model (see Figure 4-5 above) is used intrinsically. The IWB functionality observed in the case study classrooms is aligned firstly with the core; *students at the centre of their own learning*, then with the first layer; the *principles of effective learning*. Additionally the second layer is used to diagnose the contribution the IWB functionality, classroom strategies and teaching pedagogy make to developing relevant *information processing skills* for students who are considered connected learners, and who are immersed in today’s digital environment.

## 4.9 Chapter summary

This chapter has identified the research project as a long-term (13 months) case study, with the data collection methods of observations and interviews, researching the real-life phenomenon of IWB in a primary classroom. Also identified are the data collection methods and procedures for the pre interviews, observations and post-observation interviews conducted as part of the case study research. Because the researcher was intruding on the classroom environment and requiring time for interviews from teachers who were working to tight schedules, the intended observations and interviews times were flexible. Data collection difficulties were experienced due to unforeseen circumstances. Any inadequacies have been highlighted and the effects noted on the data collection procedures. Ethical considerations have been noted in relevance to the anonymity of the school and its participants, in particular the exclusion of any interaction with the children in the research data collection due to ethical issues.

Authenticity of the data collected was validated by triangulating the evidence with interviews with the participants, the theoretical framework for effective learning (**IWBFQE – see fig 4-5 above**) and current researched literature on the IWB and its use in education. Because of the qualitative nature of the case study, the interview transcriptions proved invaluable in supporting and making connections, identifying patterns and collating the evidence of effective student learning opportunities from the observed lessons.

After each classroom observation, the field notes were read to extract the themes suggested in the question criteria (see outlined criteria in section 1.1.1). Then the field notes were compared to the transcribed interview data from the teacher being observed. Finally, the field notes were analyzed with the following three of the theoretical frameworks identified and described in this chapter. They are:

1. **Interactive whiteboard to facilitate quality education (IWBFQE- see Figure 4-5 above)**
  - **Students at the centre of their own learning**, problem solving, critical and reflective thinking

- **Principles of effective learning** - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
  - **Information processing skills** – appreciation and pre-search, search and interpretation, communication and evaluation.
2. **Preferred learning styles** (Honey & Mumford, 2000). (see Figure 4-3)
- **Activists** prefer hands on, problem based learning, new experiences and involvement with others.
  - **Reflectors** prefer watching, thinking, and reflecting on what has happened as a preferred way of learning.
  - **Theorists** like to think through problems and proceed step-by-step using models and analogies.
  - **Pragmatists** learn best by applying new information to real practice.
3. **Stages of cognitive development** (Woolfolk, 1998).
- Sensorimotor (0-2 years)
  - Preoperational (2-7 years)
  - Concrete operational (7-11 years) – age of students being observed
  - Formal operational (11-adult years).

Primarily the **IWBFQE model** will take the focus of the analysis and the other frameworks *preferred learning styles* (Honey & Mumford, 2000) and *cognitive stages of development* (Woolfolk, 1998) will be identified and interwoven into the data analysis and discussion accordingly.

The next chapter analyses data collected in this research from interviews with school leaders and teachers and analysis of observed lessons where the IWB was used as a tool and finally ends with a discussion on the changes to the physical environment when the IWB technology is introduced to a classroom.



## **Chapter 5      Analysis of Data Collected**

### **5.1   *Analysis of Demographic data collected***

At the initial interviews, demographic data was collected from each participant (teachers and school leaders) to gain an insight into the background and fundamental information about *gender, position within the school and influence, teaching experience and background, and technology and IWB experience* (see Figure 5-1 below). The following sections are the analysis of the data collected.

#### **5.1.1   Gender and years in educational sector**

The case study participants' gender (see Figure 5-1 below) reflected the general gender distribution in New Zealand state schools. All the teachers observed and interviewed were female and the Principal and associate Deputy Principal were male. As at 2008, there were approximately 14,360 male teachers employed in New Zealand state schools, significantly less than the 36,590 female teachers. Today, females hold 45% of the principal positions. This has steadily increased since 1999 when it was recorded at 9.9%. Overall, there are still far fewer women in leadership positions in the educational industry (Education Counts, 2009). In a recent paper on teacher confidence and using ICT in the classroom for teaching and learning, Jamieson-Proctor and Finger (2008) identified in their findings that the imbalance of genders in teaching positions correlates to the fact that female teachers are often less confident in using ICT with their students in their classrooms for teaching and learning. As all of the teaching participants in this study were female, this finding could not be validated.

The teachers had over 90 years of educational experience between them (see Figure 5-1 below). Only one of the participants could be considered new to education with only three years experience. Teacher experience and maturity is a significant factor in the successful implementation and effective use of IWB technology in the classroom (Haystead & Marzano, 2009). However, this finding has been challenged by educationalists Kennewell and Morgan (2003) who reported that 97% of student teachers in their research expressed that they were keen and eager to have the IWB as a resource in their classrooms.

### 5.1.2 Positional influence on ICT strategy and e-maturity

It was thought that the positional influence (see Figure 8-1 below) of the participants within the school might have been reflected in the organizational commitment to the implementation of ICT into the school. The Principal has been at the school since 2007 and the Associate Principal joined the school one year later, in 2008. Together as leaders of the school, they have used their positional influence to encourage the use of ICT in the school, as explained below-

*“People start to see the benefits of it [ICT] a little bit, because essentially the way ICT I think was introduced to education was it wasn’t really sold in terms of what could be the potential of ICT and its contribution to learning. It was just shiny new toys and how cool. Recently, people [teachers] are starting to see that in fact this can change the way that children have learning experiences, and particularly individualized learning experiences. So once you get the purpose for it you start to get the motivation to get on board with these things” (Associate Principal, personal communication, August 11, 2009).*

Both the Principal and Associate Principal in this Case study are seen as modelers and integrators of ICT in their school. Their influence and expectations that staff members participate in ICT professional development, such as the *ICT Cluster program* (see Section 3.4.3), and the *INFOLINK* paper (which is part of the Graduate Diploma of Education at Auckland University designed to improve the information literacy skills of students) were all strategies designed to ensure ICT was a priority in their school. The teachers appear to have similar amounts of positional influence, except for the ICT co-coordinator who takes on the role of supporting and influencing other teaching staff in the benefits of ICT within the school. Together, all the participants identified that they share IWB resources and content they have created, and encourage other staff members to come into their classes and view their activities undertaken with the IWB as ways of encouragement and support for ICT within the school

### **5.1.3 Class teaching involvement**

It was originally thought that identifying whether the participant was involved in the classroom and actively using the IWB (see Figure 5-1 below) might reflect the attitudes and opinions of the contribution technology may have on learning. Whilst their active teaching involvement did not directly influence their attitude towards all ICT, it did reflect a very important aspect of the research; that of the positive organizational support for ICT within the school. An example of this is the Associate Principal, although not in class often as an active ICT user within a lesson, he was a key driver of use of ICT across the school. Since being employed in 2008, he has instigated a number of the ICT strategies within the school, in particular the redesign of the school website, with interactive tools for the students and parents, blogs, wikis, e-learning zone for students with literacy and numeracy games, all of which contribute to the e-maturity of the teaching staff and students.

All of the teaching participants in this research project identified an increase in exposure to ICT over the last couple of years. Whilst many participants expressed that ICT was not their personal passion, they all expressed their personal awareness that there is a need for education to prepare students for a digital society.

### **5.1.4 Personal attitudes towards the IWB**

By asking the participants to express their personal attitudes towards ICT and in particular the IWB, this information was used to reflect the participants' approach and flexibility of thinking in the use of ICT in education. With this insight, parallels can be drawn, about the way they use the IWB in their classroom (see Figure 5-1 below).

Although almost all of the participants expressed the fact that technology was not a passion, they were accepting of the need for ICT to be embedded across the curriculum. Below is a typical example of what all participants expressed:

*“I am using it [IWB] and I like it. I was skeptical to start with and I only really pushed to get one because I knew it was the way things are going to go and I needed to know how to use one. I didn’t really want one, but I went to a conference last year and that was really exciting because it was lot of people who were really passionate and could show you all sorts of tempting bits about what you could do so I got an idea of what was possible with them [IWBs]” (Teacher 3, personal communication, July 23, 2008).*

It is not until you actively use technology and experience the pros and cons of using the technology that you see the potential and understand the opportunities that the resource can offer. Like the Ministry of Education’s strategy (see Section 3.4.2) where they supplied Laptops for Teachers and school leaders to use and become familiar with, all the teaching participants in this Case study very quickly saw the potential the IWB could have for the content delivery and student engagement.

<i>Case study Participants</i>	<i>Gender</i>	<i>Years In Education</i>	<i>Positional Influence</i>	<i>Class Involvement</i>	<i>experience with IWB</i>	<i>Attitude towards technology in the classroom in particular the IWB</i>
<i>Principal</i>	<i>Male</i>	<i>28</i>	<i>1</i>	<i>Partial (Fill In for teachers)</i>	<i>0 (when filling in)</i>	<i>“I do have a concern that with so much information, so much content out there that I think there is a danger that children will become highly skilled but ignorant, they are very sophisticated users of IT, they can communication with each other using the tools easily”.</i>
<i>Associate Principal</i>	<i>Male</i>	<i>10</i>	<i>2</i>	<i>Partial (Fill In for teachers)</i>	<i>0 (when filling in)</i>	<i>“I guess ICT was not an interest of mine before I became a teacher so I am actually only interested in it from an educational sense. I mean personally I use computers but it is not a passion of mine. But I am passionate about it in education, so it’s quite specific to the job really”</i>
<i>Teacher 1 (ICT Coordinator)</i>	<i>Female</i>	<i>8</i>	<i>3</i>	<i>Full</i>	<i>2</i>	<i>“I am an active board addict”</i>
<i>Teacher 2</i>	<i>Female</i>	<i>10</i>	<i>4</i>	<i>Full</i>	<i>2</i>	<i>“Well, I would say the active board I absolutely love. I could not teach without it. I could not actually go back to using pieces of paper. Too boring for me after having it”.</i>
<i>Teacher 3</i>	<i>Female</i>	<i>12</i>	<i>4</i>	<i>Full</i>	<i>6 months</i>	<i>“I would find it a problem [to teach without the IWB] because I do really like it as a visual aid and I like being able to store any piece of work or learning that you have done”</i>
<i>Teacher 4-</i>	<i>Female</i>	<i>12</i>	<i>4</i>	<i>Full</i>	<i>6 months</i>	<i>“I was really skeptical to start with and I only really pushed to get one because I know it was the way things were going to go”</i>
<i>Teacher 5</i>	<i>Female</i>	<i>3</i>	<i>4</i>	<i>Full</i>	<i>6 months</i>	<i>“They love it, they enjoy it, I enjoy it. Sometimes you use it more as a board for some activities like handwriting, but other times you can flip to WebPages or different activities you have created and the kids love it. There is always all hands up when it’s active board time”</i>
<i>Teacher 6</i>	<i>Female</i>	<i>10</i>	<i>4</i>	<i>Full</i>	<i>Mobile IWB Often</i>	<i>“I think they are brilliant tools, however you can still do stuff with a data projector and screen, but you can’t save your work”</i>

Figure 5-1 Demographic Data from Case Study School

### **5.1.5 Findings from Demographic data collected from participants**

In this section, the demographic data reflects the norm in male/female staff and management distribution in New Zealand schools, where leadership are male and all teaching participants in this case study are female. Positional influence did reflect that the organizational culture is supportive and the school leaders were modelers of ICT in their school.

All teaching participants spent either all or some time in the classrooms using the IWB technology. It could be said that this school are new users of the IWB technology, with the most experience IWB user having two years experience, and the least experienced user only six months. Overall, the case study participants could be considered as new users to the IWB technology.

Whilst the majority of participants were skeptical from past ICT experiences of the contribution, all of the teaching participants voiced that they would not like to teach in a classroom without the IWB technology, now that they have had the experience with it. A number of strategies have been introduced into the school by the new management team in using the IWB technology.

## **5.2 Analysis of Data collected from Interviews with school leaders**

Two interviews were conducted with each of the school leaders, the principal and associate principal. The first interview established the position the school had towards ICT in education. The second interview built on themes identified in the first interview. The following themes are discussed; the ICT strategic plan, funding and infrastructure, the impact of the IWB technology on the new curriculum and learning theories and strategies.

### **5.2.1 ICT Strategic plan**

In 2007, the school saw a change in leadership with the employment of new principal. One year later, a new associate principal was employed. With this new management team, came an informal ICT strategic plan, resulting in a number of moves to increase the use of ICT in their school. These strategies included an upgrade of the networking infrastructure, an upgrade of the computers in the dedicated computer pod, a complete overhaul of the school website, the formation of an ICT Committee, and the inclusion and participation of all staff in the ICT professional development cluster program (see Section 3.4.3). All of these strategies contributed to the current e-maturity of the school. As the school comes to the end of the ICTPD cluster program (three years of ICT training), a significant change in competency in the use of ICT with the school has been noted by the principal:

*“There has been a huge change in skill levels and uptake in the use of ICT by the teachers. This is ICT in a broader sense and in the confidence and uptake in teachers in their own administration. The use of ICT in the classrooms has expanded markedly and some of the more visible outcomes are that more teachers now give out their email addresses to parents and what we have found is that we now have a database of email address for 98% of parents which is why we can communicate with a digital newsletter.”*  
(Principal, personal communication, August 4, 2009)

Although the Board of Trustees, Principal and Associate Principal were supporters and modelers of ICT, opinions and attitudes towards using ICT in teaching and learning, in particular lesson planning, still involved hesitation from some staff, as explained by the associate principal:

*“Some teachers I feel have gone right up there in terms of what we are aiming to achieve with students and ICT. I think others are still of a different mindset and ICT is something we do because it is on the timetable. I think the direction of the school is very much in line with the thinking of the people who got on board with the idea that ICT is a tool that is part of the fabric of teaching and learning. Therefore, to whatever extent people’s skills have developed, I think that mindset is the crucial thing and that is a very difficult thing to change, particularly in education.” (Associate Principal, personal communication, August 11, 2009)*

### **5.2.2 ICT Funding and Infrastructure**

This case study school is ranked as a decile 10 school. The decile rating is a result of information gathered on the socio-economic background collected from the five yearly census questionnaire sent to every home to gather a snapshot of New Zealanders. As a decile 10 school, it is understood that that this school has a small proportion of students from low socio-economic backgrounds, therefore the school will receive less operational funding from the Ministry of Education and rely more heavily on the contribution parents make to the school.

With this in mind, careful management and planning is required for the best use of the ICT budget. For the case study school, the Principal advised that when selecting technology, a significant part of the decision was identifying what technology could provide most interactivity to the students.

*“They [IWB’s) are expensive. Compared with other IT, we have just bought 10 Apples [ibooks] to use in the Year 7 classes for much less than the cost of an interactive whiteboard. Therefore, in terms of bang for buck I still think there is some dialogue that is worth having around that area. What we are trying to do is get as much technology under the children’s fingers, as we possibly can.” (Principal, personal communication, August 4, 2009)*



Another area of concern for the management team was the theft of technical equipment in the school. In the following statement, the principal outlines that further costs associated with the implementation of expensive technology, as is the case with the IWB technology, are an additional financial consideration: -

*“My other reservation and it’s incredibly mundane, but for us it has been an issue, they [IWBs] attract thieves. Most of the break-ins in the school were targeting the whiteboard projectors. However, they are useless to the thieves, especially the new ones they have a short throw lens and they have no external controls.” (Principal, personal communication, August 4, 2009)*

### **5.2.3 New curriculum and inquiry based learning strategies**

After years of suggesting the need for flexibility in the school curriculum, the Ministry of Education released a new curriculum document in 2007 (Ministry of Education, 2007). In this document a vision for students was outlined, ensuring students are confident and motivated, connected and effective users of communication tools, active participants in a range of lifelong contexts, and with the skills to become lifelong learners. The new curriculum also offered schools the opportunity to review and re-design their main curriculum learning areas, English, Mathematics, Science, Arts, Social Sciences, Languages, Health, and Technology with more flexibility in their choice of delivery. There was the clear identification that the principle direction for teaching and learning was to ensure the student was at the centre of teaching and learning.

As the case study school is currently working on the revised curriculum, a current topic of conversation amongst the staff is *“what knowledge is important”* for our students. How do teachers ensure that children have the information processing skills not just to access information, but also to ensure that the information they have access to via technology is necessary and required. The principal explains:

*“Well I believe it’s one of the critical questions of our time and I guess I have got a position where I believe that there is a knowledge that is worth us having. [Knowledge] to have it as part of who you are. To function in a democracy, you have to have an understanding of law, and how laws shape civilizations. To be a citizen, if you are an empty vessel of skills that deletes when you finish doing something, ready to take on the next thing, that’s not anything I would want for any child in my school” (Principal, personal communication, August 4, 2009)*

However, as one of the case study participants identifies, the flexibility in the delivery of the curriculum could be seen as an opportunity for a change in effective learning or not:

*“The curriculum is very broad now, so you can decide what you want then put it how you want to teach it basically. So it is more up to you how you want to teach it because you could take anything from the curriculum and sit them [students] down and do a worksheet for the whole lesson or you could take it and do something on the active board so you can get to choose what you want to do.” (Teacher 5, personal communication, June 5th 2009)*

Additional to a more flexible curriculum and the increasing use of technology in the Case study school, one recent and noteworthy change is the participation of all the teachers in the **INFOLINK** paper. This course is a foundation course in the Graduate Diploma of Education at Auckland University designed to develop teaching skills in information literacy, how to access information, evaluate, synthesize and interpret and reconstruct relevance to enhance a student’s personal learning. The **INFOLINK** course underpins the contemporary learning theory of ***inquiry-based learning***. While originally identified in the field of science and the incorporation of scientific reasoning and critical thinking, today, it can be applied as a teaching method to increase student’s interests in a topic, utilize information processing skills and more importantly engage in student-centered learning.

The case study school has identified that their approach is to promote ***guided inquiry-based learning*** throughout their school curriculum. Guided in respect that they believe students require

support and careful management in practicing their skills for inquiry-based learning. Seated in the social constructivist approach to learning, guided inquiry-based learning fits comfortably with using technology as a tool for students to self-direct or take ownership of their own learning, whilst being supported by the teacher to ensure the relevant outcome. The Associate Principal explains:

***“Guided inquiry is very much still structured, still giving kids a very clear process to work through, but it’s giving them a bit more autonomy within that, getting the balance right and the integration of ICT.” (Associate Principal, personal communication, August 11, 2009)***

When using technology as a tool for gathering information, it is clear that there is a real need for comprehensible information processing skills that are critical in today’s classroom environment. With students of this Case study school, it was clear to the school leaders that this process should be a consistent approach throughout the curriculum. The Associate Principal explains:

***“It’s about teaching the students a process and part of that process is about analyzing information and taking what you need and discerning which stuff is actually not valuable to you so it’s about teaching students an actual process that when they need to find out stuff they will go through certain steps and at the end of it they will have a good end product.” (Associate Principal, personal communication, August 11, 2009)***

In this Case study, the school appears to be going through a major shift in teaching pedagogy with the introduction of guided inquiry-based learning. The Principal explains:

***“Guided inquiry is a constructivist approach rather than a transmission approach or pedagogy and I think most of us are trained in a constructivist approach. Guided enquiry sits on top of that foundation. A certain amount of direct teaching is required and in fact, one of the things that challenges people’s assumptions about guided enquiry is that in order to engage properly with an enquiry you do need prior knowledge and some of it will just come through direct teaching. It is called the***

*immersion phase of guided enquiry. Guided inquiry is based on rich questions and unless you have some prior knowledge of your questions, they aren't going to be rich questions.” (Principal, personal communication, August 4, 2009)*

As identified in the **IWBFQE model** (see Figure 4-5) the **appreciation and pre-research stage** of information processing is essential to forming the basis of an effective learning and information processing opportunity. Here the IWB technology can be a useful tool. As indicated in the conversation below, the IWB functionality can ensure the whole class is engaged and informed of the prior knowledge surrounding the topic (immersion phase). The usefulness of the IWB functionality for information processing and guided inquiry is highlighted by the Principal below as a powerful combination for effective learning:

*“The IWB becomes a powerful tool [for guided enquiry], because they can all share information online, discuss it, review it, practice some of the skills like skimming and scanning, and evaluation.” (Principal, personal communication, August 4, 2009)*

Ensuring that children are not just skilled at accessing information, but also have the skills to process the information and form a knowledge base, can be seen as a second layer of the **IWBFQE information processing model** (see Figure 4-5). **Evaluating, interpreting and communicating information** are seen as necessary skills in information processing that contribute to effective learning opportunities.

However, the attainment of these skills can be controversial. When considering the case study students and their cognitive development levels, Piaget's theory identified that children aged 7 to 11 should have the ability to think logically and practically, but not abstractly (Woolfolk, 1998). However, in guided inquiry-based learning we are asking the students to evaluate, interpret and present information. This could be a difficult ask for these students of this age, if they have not had the opportunity to practice these skills before. The IWB functionality can be used to practice information processing skills of evaluation and interpretation. The wide variety of multimodal opportunities, video, audio, animation, resources to show real examples can be combined with abstract conceptual examples. Students have the opportunity to classify group ideas and extend

complex examples, beyond their suggested development stage. The opportunity for the students to present their information using the IWB technology would ensure the student is “hands-on” at the centre of their own learning, while communicating their gathered information.

#### **5.2.4 Findings from Interviews with school leaders**

In this section, it has been clearly identified that the Case study school is going through some significant changes concerning ICT in their school at present that will affect their teaching pedagogy and learning outcomes in the next couple of years. With the incorporation of the revised New Zealand curriculum, the implementation of an ICT strategic plan, and the collective up-skilling of teachers in information literacy and guided inquiry-based learning the Case study school is in the process of change.

While the direction of the school leaders appears to be incorporating some significant changes in teaching, the curriculum and the implementation of technology into classrooms, it appears that the teacher is still the dominant factor in deciding the lesson structure and whether technology will be used to complement the lesson or not.

### 5.3 Analysis of data collected from interviews with teachers

When conducting the interviews with the participants, it was intended that the interview would be a conversational open-ended discussion in order to understand the attitudes and opinions of the participants towards ICT and in particular the IWB technology. The following analysis of the interviews draws heavily on the first layer of the *IWBFQE (Interactive whiteboard technology as a facilitator of quality education)* model which identifies the principles identified that are conducive to effective learning as follows:

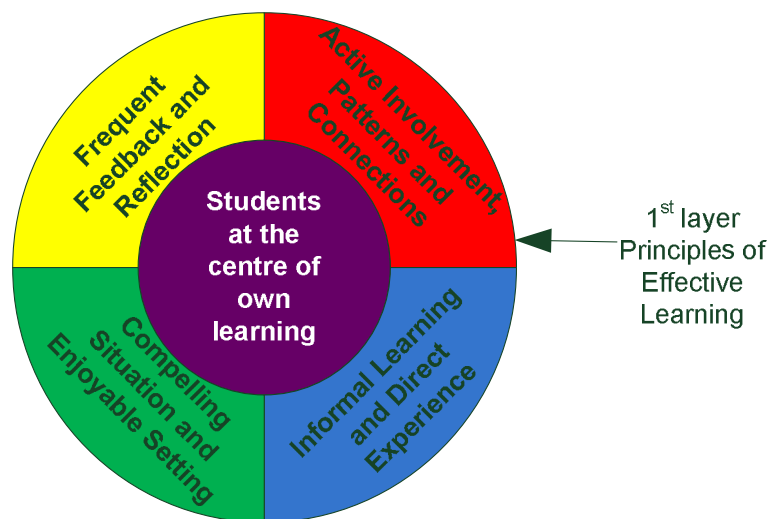


Figure 5-2 1st Layer of Interactive Whiteboard as technology as a facilitator of quality education (IWBFQE) - Principles of effective Learning

#### 5.3.1 Evidence of engagement and motivation

The makeup of many of our New Zealand primary classes is of 1 teacher and up to 30 students per class. Engaging and motivating this number of children in a whole class, many of whom have a variety of learning needs and styles, is often an incredibly difficult task for teachers at times. As most teachers know, engaging students with the topic is paramount in ensuring learning is effective. With the variety of functionality provided with IWB technology, engagement is evident in all of the observations in the Case study. Visually stimulating images, video, audio

clips, the large and enveloping presence of the IWB was undoubtedly an opportunity for engaging students when introducing a lesson topic. A comparison of traditional methods of teaching and the opportunity for engagement with the IWB technology is explained by a participant below:

*“When you are teaching on a piece of paper, say it might be A3 size, I am sure half the children can’t see it and that’s the reality in a classroom of up to 30 children. Whereas on the active board all of my children can see it and I don’t have any concerns about them not being able to see, they can all see it. The size makes a huge difference, but also it is a lot more visually appealing I suppose. I am not very arty, so in the past it would take me ages to draw little pictures and make them look pretty, whereas with the active board you can drag up backgrounds, drag up pictures etc.” (Teacher 2, personal communication, July 23, 2008)*

When comparing the traditional static whiteboard, the finite space and the time it takes to write up or draw a picture to the IWB technology and functionality, the opportunity for engagement of the student is enhanced enormously. Engagement of the student contributes to the ***compelling situation (IWBFQE)*** (see Figure 5-2 above), where the student is persuaded to invest time in looking and listening. Once the student takes the time to engage in the topic, then the opportunity for learning needs to be carefully managed from here if a successful outcome is desired. The incorporation of problem solving and challenges has been promoted as harnessing the engagement, but careful management of the level of challenge is advocated by Ewell, as too much can encourage the engagement level to drop and the ***“brain to turn off” (Ewell, 1997, p. 3)***. The successful management of engagement can encouraged by seamlessly increasing the opportunities to see ***patterns and connections (IWBFQE)*** (see Figure 5-2 above) allowing the student an opportunity to make meaning personally of the central topic by interrelating situations or past experiences. (Finger, et al., 2007),

*“Cognitive science tells us that individual brains learn to make themselves work actively and individually by establishing new patterns and synaptic connections.”*  
(Callahan & Switzer, 2004)

The IWB technology offers the opportunity to re-establish patterns, make consistent connections in a timely manner for learning and understanding. A case study participant explains:

*“This morning I did a maths lesson and the group was going away and doing a little doodle grid [number grid], and I wanted to give them an example of what they were doing, so I modeled what they would be doing on the IWB board, took a picture with the camera tool on the IWB, transferred it into Word and printed them a copy for their maths books, and sent them away to do the task and none of them had a problem, because it was a pattern they had seen.... And because they were a lower maths group, it was such a great tool for them to reproduce exactly what we had done on the IWB.”(Teacher 1, personal communication, July 23, 2008)*

If used effectively, the IWB can offer an opportunity for a wide and varied learning environment within the constrictions of a limited time of a five-hour school working day. This is a tool that allows the teacher to create a fun, diverse, dynamic and complex multimodal lesson for students. Many educational researchers have identified the pace and the seamless delivery of a lesson as an advantage of using the IWB in the lesson as a contributing factor in gaining and sustaining the engagement and motivation of a student during the lesson (Beauchamp & Parkinson, 2005; Gillen, et al., 2007; Kennewell & Beauchamp, 2003). One case study participant expresses how the teacher’s physicality when using the IWB allows an opportunity for a seamless delivery of content:

*“I think they [students] definitely pay more attention and I guess that is a deeper learning if they are always engaged. I think the big thing with a whiteboard [static whiteboard] is that sometimes you have to turn your back to keep writing and that’s when kids can get up to mischief or be distracted. However, if it’s there already in front of you and you have just got to flip a page and the kids are pretty much doing it themselves you have never got your back to them.” (Teacher 5, personal communication, June 5, 2009)*



As previously discussed, one cognitive strategy the IWB supports is the enhancement of the knowledge base that students may have of a topic when the lesson is introduced at the start of class. The IWB functionality assists in supporting the interaction of teacher and the student dialog. Using the power of technology to produce, categorize and save affords students the time for re-appraisal, confirmation of their own existing knowledge and an increased opportunity for dialog and questioning (Mackenzie, 2006). In data gathered during the observations of the Case study classes, it was evident that the teacher often introduced the topic as a question on the IWB, and then together with the whole class created a discussion to form the foundations by brainstorming and writing the student ideas on the IWB. These brainstorm files are saved and revisited during the lesson. A Case study participant explains how the IWB tools can be used to brainstorm a topic with the whole class:

***“I found the IWB very helpful with brainstorming and moving things around. Putting them into the different categories rather than a piece of paper where you are scribbling all over the place. With the IWB, you can pick it up, color code and organize the lesson well. Even scanning text and highlighting the important bits.”(Teacher 2, personal communication, July 23, 2008)***

This opportunity for creating the timely connections with IWB functionality of revealing, reversing, repeating, color-coding and hyper linking to other resources were the opportunities where both the IWB technology and good teaching pedagogy concluded in effective learning opportunities for students. Educationalists (Beauchamp & Parkinson, 2005) identify the flexibility of the IWB in its ability to annotate certain sections of a lesson, such as using a microscope over an image for closer inspection, or using the pen to highlight sections for clarity. All of these features allow the teacher to create visual patterns, highlight connections or change the direction of the lesson seamlessly because of student interactions, conversations and feedback.

Part of good classroom management is creating a good learning atmosphere within the classroom. If the classroom constitutes a setting that feels good to learn in, both physically and psychologically, the learning and teaching is both enhanced and a worthwhile experience for all.

This is explained by Dr. Kay Fielden (1995) in her research into enhancing the learning process in a technical environment. Fielden identifies that the learner's intellectual journey is closely related to their emotional and spiritual state and the support of the physiological aspects; states of consciousness of the learner are conducive to a more meta-cognitive learning experience. Ensuring teachers are cheerful, supportive and passionate, aware of the social and cultural needs, and confident in managing conflict, are all aspects of contributing to an ***enjoyable setting (IWBFQE)*** (see figure 5-2) and preparing a conducive environment for learning.

Fielden's research complements the work of Eric Jensen(2008) who believes that the brain and its cerebral characteristics have significant implications on learning. Based in the field of neuroscience, Jensen highlighted the need for teachers to show a positive attitude in every class they facilitate. He states that if teachers show they are happy to be there, passionate about their topic, are humorous and contribute to a pleasant learning environment, then this enjoyable setting will bring out the best in their students. In this Case study, it is obvious that the IWB technology has contributed to a renewed passion for teaching for many. The following case study participant explains the inevitable monotony that some teachers experience after teaching with the same tools year after year:

***“Teaching with the same tools gets a bit boring when you have been doing it for a while. I love the Active board. I like to play around with it and all the tricks on it, and I would find it really hard not to have one. I will be looking for a position that has an Active board [in the future] because I know there is a lot of stuff I don’t know how to do yet, but I do know what is possible with it.”(Teacher 3, personal communication, July 23, 2008)***

It could be concluded that if the teacher is passionate about their teaching tools, then the effect will assist in the teacher's contribution to engagement, motivation and the creation of a ***compelling situation and enjoyable setting*** for the students (***IWBFQE***) (see figure 5-2). A case study participant explains:

*“Well I would say the active board, I absolutely love it. I see it as being very beneficial, it is great to use and to teach with. I think it makes a huge difference with my children with their participation and their concentration. And just their enjoyment.” (Teacher 2, personal communication, July 23, 2008)*

However, when new technology is available, there is a need for teachers to constantly reflect on their practice and check for the possibility of technology overload and the so-called appearance of engagement which could be seen as the ‘*dumbing down*’ of student behavior and not an opportunity for deeper learning. A case study participant identifies the reality of the class sizes and concentration issues that teachers face every day.

*“This year I have 17 boys and 10 girls and a few of my boys need firm boundaries and can be problematic. I have no way of proving it, but I feel that if I didn’t have that active board I would be very stressed out with 17 boys trying to keep them focused, on task in the classroom, especially because they are quite talkative characters” (Teacher 1, personal communication, July 23, 2008)*

### **5.3.2 Evidence of Interactive learning**

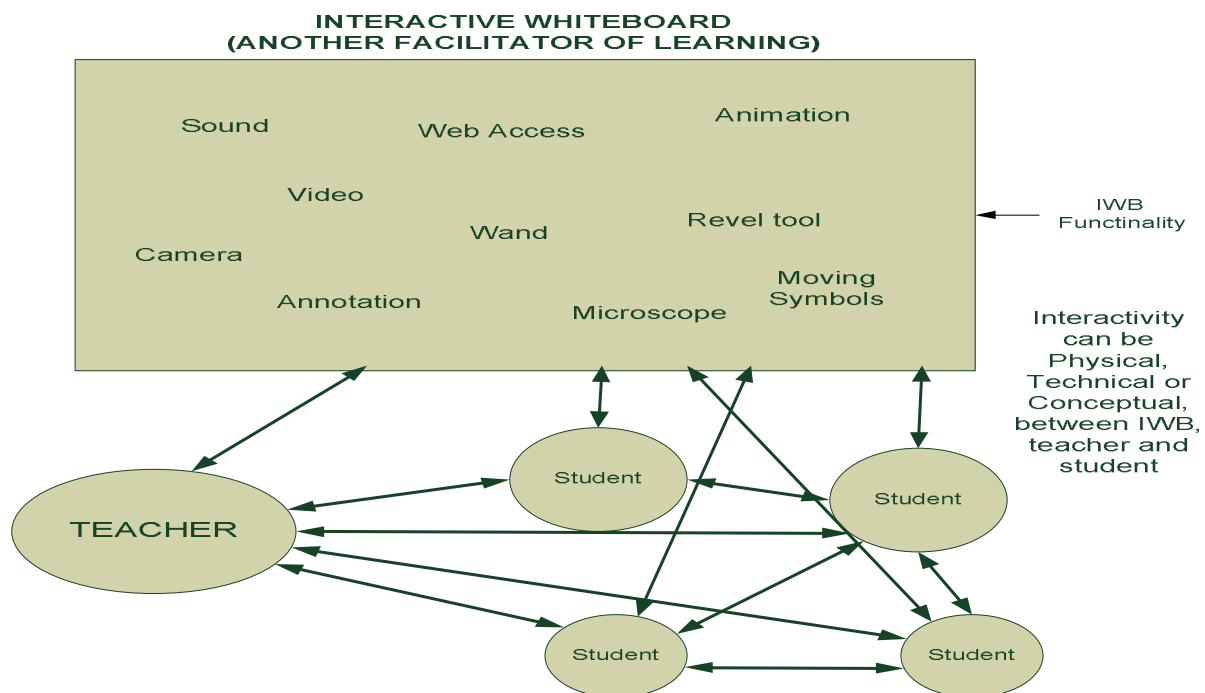
One consistent doubt expressed by one of the case study participants in an earlier interview was that the IWB technology would constitute a backwards step to “whole class teaching”. Whole class teaching implies that the teacher is very directive in the teaching style and the flow of information flows in one direction, from teacher to student. A case study participant explains:

*“Students of today are not seeing the need to put together bits of information themselves, but expect it to just be there for them. I think there is a need to consciously teach and encourage students to make links between different pieces of information they are getting because there is an increasing tendency to become more and more passive. They expect to have stuff to watch or listen or to be told and that level of synthesis is not any higher than it was before [without the IWB].” (Teacher 4, personal communication, July 23 2008)*

This chance for the IWB technology to overawe the teacher as well as the students, thereby limiting the opportunity for deeper learning, is currently a cause for debate. As a result of the new curriculum calling for personalized learning for all students, the opportunity to include more student interactivity is paramount. The term *interactive learning* can be quite ambiguous, and for most, the term “*interactive*” constitutes the idiom for hands-on involvement, in particular a physical incidence of learning. However, as educational researchers Jewitt, Moss and Cardini (2007) identified, there are other ways we can interpret the expression “*interactivity*”. These are relevant to the use of the IWB functionality:

- *“Technical interactivity –where the focus is on interacting with technological facilities of the board*
- *Physical interactivity – where the focus is on going up to the front and manipulating elements on the board*
- *Conceptual interactivity –where the focus is on interacting with, exploring and constructing curriculum concepts and ideas” (Jewitt, et al., 2007, p. 312).*

The IWB affords opportunities for students to participate in *physical interactivity* and *active involvement (IWBFQE)* (see Figure 5-2 above), by allowing the student to come up to the board and manipulate the IWB symbols with a wand or pen. However, the technology can also be used interactively with the technological and conceptual functionality. The inclusion of multimodal resources (**technical interactivity**) such as video and audio and increasing opportunities for timely learning conversations (**conceptual interactivity**) between teacher and students, and the co-construction of content are evident with the IWB technology. Figure 5-3 below shows how the IWB can effectively become another facilitator in the learning landscape. The *technical, physical* and *conceptual interactivity* opportunities are increased with IWB functionality, as the interaction is now three ways - between the teacher and the IWB, between the teacher and the student, and among the students, as shown below:



**Figure 5-3 Interactivity between teacher, student and IWB functionality (Researcher's own model)**

The IWB can promote a variety of interaction, however, if the teaching pedagogy does not recognize this variety of interaction and contribution that the IWB functionality makes to learning, the opportunity for learning will not be maximized. In the whole class learning environment, interactions can quite often be a “hit and miss” opportunity for learning if not facilitated properly. In research carried out by Burns and Myhill (2004) which focused on “interactive whole class teaching” the authors identified the conversations between teachers and students or linguistic interaction in whole class learning as contributing to this inconsistency of effective learning. The author's outcomes identified the following factors as pitfalls evident in the nature of whole class interactions: the disparity of contributions from the whole group, a lack of shared exchanges from the group, an unevenness in the control and power within the group. With this in mind, it could be noted that if the teaching pedagogy is less dominant when using the IWB and the IWB technology is considered an additional facilitator of content, response and learning interaction, then the technology can supplement the *conceptual interactivity* contributing to reducing the disparity of contributions during whole class teaching.

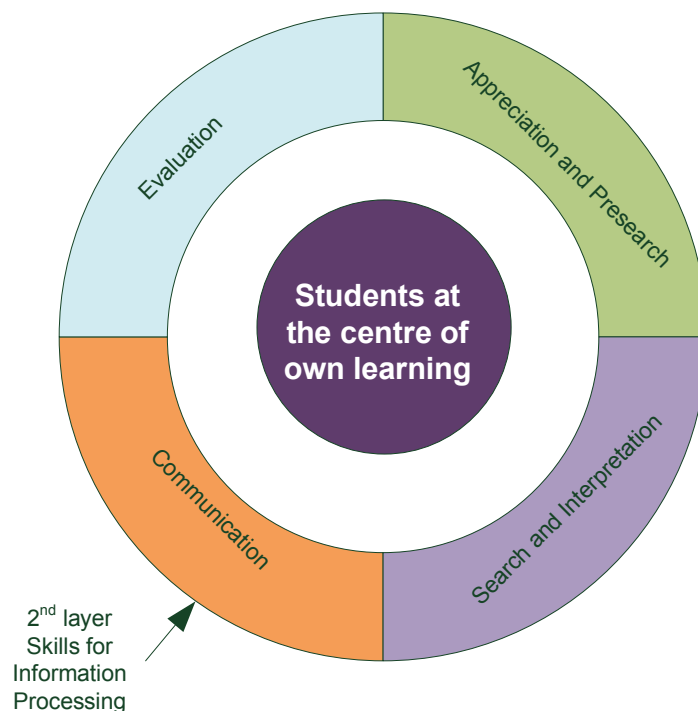
However, many of the observations saw the hands-on ***physical interactivity*** limited with only some of the lessons involving physical interactivity of the students. Whilst not evident to the teacher, the IWB technical functionality (sound) combined with linguistic interaction, as a whole class, was also contributing to the ***conceptual and technical interactivity***. A Case study participant explains their personal perception of interactivity:

***“The kids love the interactive part because (as an example) when we are doing flight, I looked at transport and made a flip chart with different transport pictures and found Maori words to go with them. The kids have to find the right place and then move with the pen to the word next to the picture, if correct that particular sound is heard. All the kids’ hands are up to answer the questions and the children run the lesson with little input from me.” (Teacher 1, personal communication, July 23<sup>rd</sup>, 2008)***

In some classes observed there was little or no evidence of interactivity when using the IWB technology as a resource. The lesson followed the more conservative role with the teacher maintaining control of the structure of the lesson, using a one-way didactic distribution of knowledge, with some questions to students, using the IWB as a whiteboard to record answers, without any technical or conceptual interactivity by way of multimodal functionality or co-construction of knowledge.

### **5.3.3 Evidence of effective skills in Information Processing**

The Case study school’s incorporation of a ***guided inquiry-based learning strategy*** merges well with the necessary skills required when using technology in the classroom to process information effectively. The second layer of the ***IWBFQE model*** (see Figure 5-4 above) identifies essential skills required to search, process, interpret, evaluate and communicate information which using technology. The ***guided inquiry-based learning*** approach fits comfortably when students are using technology to gather their own information, developing the skills required when faced with large amounts of information using ICT tools.



**Figure 5-4 2nd Layer of IWBFEQ - Skills for Information Processing**

In theory, the introduction of ***guided inquiry-based learning*** can contribute to a student centered learning approach. However, as discussed in section 5.2.3, not all students have the level of cognitive development required for student-centered inquiry-based learning. Being able to understand or practice the skills for information processing can be difficult if students have been familiar with a more teacher-directed approach to learning. A case study participant explains:

*“I will say to the students, go on this web page and find the answer to four questions themselves. I will give them say 30-40 minutes to answer four questions, if they can’t answer the four questions we get together and say right what did we do wrong and so we talk about the web pages themselves, how to skim web pages. When a teacher gives you a book, they don’t give you the whole book to read they just give you an extract from it or they give you a school journal, so they [students] are not very good at skimming. So this is a very good skill that we are teaching now because they have*

*access to pages and pages on the net, they have to be able to skim a web page and say is it appropriate or not.” (Teacher 5, personal communication, June 5, 2009)*

**Appreciation and pre-search** (see Figure 5-4) are seen as the first two stages of forming the skills for information processing, which can be encouraged in a number ways. When using the IWB technology, the visually stimulating and engaging impact on the student is evident. This engagement can form the **appreciation** of the topic. In this case study, the observed lessons often commenced with an introduction of a topic, with the use of visual aids, as in the following example from a case study observation:

*“I think my main use of the IWB has been as a visual aid. I think it has enabled me to introduce concepts and demonstrate things more easily for the children. I think it has definitely made my teaching clearer and more accessible for the children because they can see things more clearly.” (Teacher 4, personal communication, July 23 2008)*

The fact that the student can see and hear more clearly in a classroom of up to 30 other students could have a major influence on the first hand exposure and **appreciation** of the lesson topic.

The **search and interpretation** (see Figure 5-4) information processing skills incorporate the student creating a search plan to obtain the most suitable information from suitable sources. This is where the **guided inquiry-based learning** teaching approach is relevant in preparing the student with skills to not only carry out the search plan, but also assess, select, reflect and interpret the information selected. By connecting to the web and using the IWB functionality to search, skim, select and interpret information, students are exposed to a variety of resources, good and bad.

Allowing students to have the opportunity to **communicate and evaluate** (see Figure 5-4) their findings could be seen as the most important part of an effective learning opportunity. Each time a student has this opportunity to complete the information cycle, reproducing and communicating to others their collected information, they are contributing to a deeper understanding of the topic. Whilst the Case study observations did not reveal many opportunities



where the student physically used the IWB to communicate their work, the following interview excerpt did reveal that it did happen in some cases:

*“Last year we did professional development on inquiry-based learning. Rather than getting the children to do a project and write down the facts, with inquiry-based learning they are actually getting into deeper level learning and we are looking at asking big questions, finding information, answering their questions and presenting it. The active board is wonderful tool for that and I found it very helpful with doing brainstorming and moving things around and putting them into the different categories, rather than a piece of paper where you are scribbling all over the place. So found it very easy to teach inquiry with the active board and my children actually all chose to present the information on the active board as well, so they made their own flip charts” (Teacher 2, personal communication, March 27, 2009).*

Allowing students to choose the IWB to present and co-construct information, contributes to the student being at the centre of their own learning. Teachers should view the IWB technology as another class resource via which students can communicate their work, to the student a natural and acceptable way in which the majority of our students communicate today.

### **5.3.4 Evidence of improved classroom management**

As indicated by all of the Case study teacher participants in this research project, the wish to teach with an IWB in any future classrooms they may work in was imperative. The loss of the IWB as a tool was considered a backward step in classroom management by all Case study participants, even those who had only been exposed to it for as little as six months. Even after this short time, the participant teachers could gauge or predict the benefits for teaching as well as for student learning.

The IWB allows the four walls of a classroom to become non-existent, which in turn improves classroom management of resources. One way of increasing motivation for learning is by introducing a student to a problem or challenge that is relevant to his or her real life environment.

The opportunity of ownership of a problem will allow the child a sense of personal identification within the learning. Ensuring authentic life experiences are incorporated into lessons is a way in which the student can easily identify with the context. We could add that an authentic learning experience can be greatly enhanced by the use of technology, in particular the internet. The following participant explains how the IWB technology is used to enhance the student's authentic experiences as well as extending the resources available within the classroom walls:

*“We are learning about Maori culture and we went [online] to the museum to look at the things at the museum in the classroom before we even went there. We also [physically] went to One Tree Hill, so we did a virtual tour before we went there so that's like applying knowledge before they get there and they learned lots more when they went there and we have continued to learn lots more since we came back. We could click on Te Papa [online] and look at all the Maori cloaks and it was far more interesting. I could have found books and we could have looked at them in books, but I get more attention using the board [IWB] and click on the room...and when we actually went to the museum, the children would point out to me the cloaks that they had seen on the website” (Teacher 1, personal communication, July 23, 2008).*

Utilizing the IWB tools of incorporating photo images of students and recording their voices seems to give the children a real sense of ownership and excitement. This underpins the students personalizing their own learning experience, which in turn contributed to their engagement. A participant explains the use of the IWB functionality within one of her lessons:

*“The [students] just love seeing themselves and hearing their voices on the IWB. And it's letting them use it as well. I had a parent the other day say, “oh you are letting them use it” and I said of course I am. They have got to feel happy and independent and they have to be able to work out problems themselves and they do. The rule in the class is, when there is a small group working on the IWB independently, they are only to come to me with a problem if it is something urgent, but you will find they will work it out themselves or another child in the class will notice and go up and fix it.” (Teacher 2, personal communication, July 23 2008)*

When learning in a classroom which is limited to a single teacher who is using the traditional communication symbols of speaking, text on a static whiteboard, books that are held up or handouts that are given to each student, it may be difficult for the learner to follow the flow of information and communication. In order for the student to engage and simulate information, they need to make the cognitive connections, and create new threads of content to contribute to an overall picture of knowledge (Haldane, 2007). This is explained by Haldane (2007) in her metaphor for learning *“Weaving the fabric of learning”* (see below Fig 5-5). Haldane uses the analogy of weaving a fabric, to identify the teacher and their verbal dialogic interaction with the students, with the intertwining of the IWB and its functionality as an interactive opportunity for learning.

In the following diagram (see Figure 5-5), Haldane explains the *warp of the fabric* as combining the teacher’s verbal presentation as transitory explicit knowledge with a stable medium such as IWB symbols and text to enhance students *weft of the fabric* of obtained knowledge.

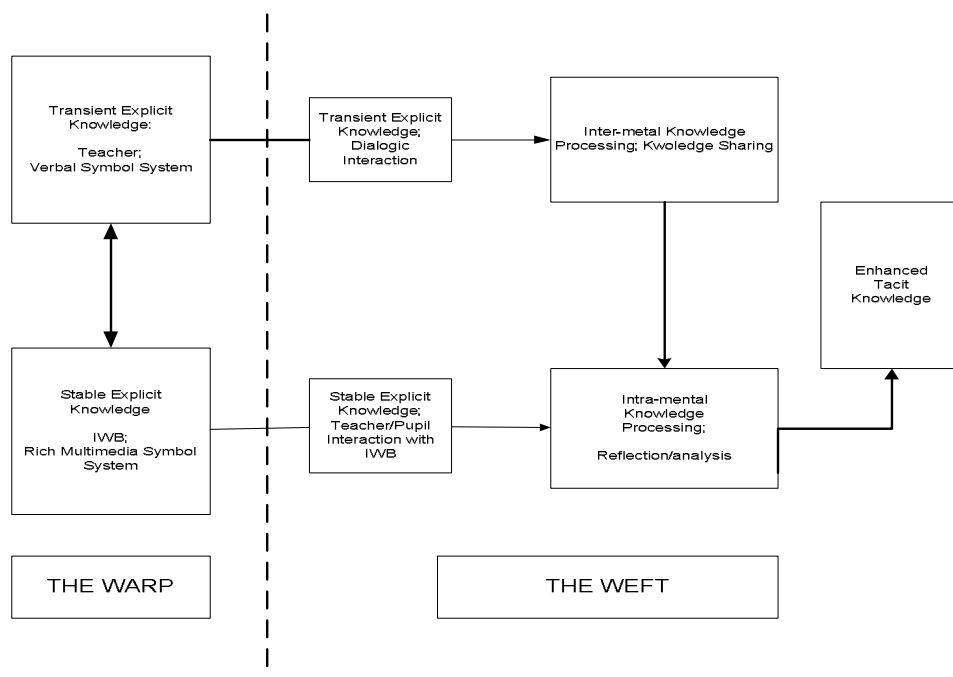


Figure 5-5 Haldane’s weaving the fabric of learning (Haldane, 2007, p. 268)

When incorporating the IWB technology into a lesson plan, the planning of the lesson is altered, not only to include when and where to use the particular functions of the IWB, but also to consider the usefulness of the functionality and its relevance to the best possible learning approach and context in which the learning is taking place.

Good classroom management is conducive to a productive learning environment, however it could be seen as unethical and an ineffectual learning environment to use classroom management techniques to control student behavior so that they are quiet and passive learners (Woolfolk, 1998). In today's classrooms of a single teacher and up to 30 children, there is a fine balance between ensuring that there are boundaries whilst ensuring that the classroom strategies are conducive to a positive and engaging learning environment.

### **5.3.5 Evidence of changing pedagogy with the IWB technology**

It is clear that a teacher's personal understanding and attitude towards student interactivity and the IWB in the classroom are a direct reflection of their personal pedagogical practice and understanding of the theory of teaching and learning.

*“How interactivity is understood and used in relation to the IWB in the classroom is shaped by their pedagogic theories of learning that underpin particular teachers' practice and that circulate more broadly in a subject department or school. It also varies according to the demands of the subject and topic, the perceived ability of the students, the time available and the peripherals used.” (Jewitt, et al., 2007, p. 312)*

From many of the interviews carried out with the case study participants, it was identified that in general the participants' interpretations of the change that the IWB technology has had on teaching pedagogy and classroom management did not reflect any particular learning theory and was not clear in their minds. They saw the opportunity for interactivity and student-centered learning happening when they asked the student to come up to the board and physically interact with the content on the board, often in pre-determined outcomes.

### 5.3.6 Comments on IWB implementation into the classroom

Whilst recording her journey of implementing an IWB into her South Auckland classroom over three school terms, teacher Sue Hodge detailed her first impressions of the IWB technology as being completely overawed and impressed with the variety of resources and functionality available (Hodge & Anderson, 2007). What she did not realize until reviewing her first six-month implementation journal was the unanticipated neglect of other learning mediums such as writing and reading. Hodge advocates that new users of the IWB technology need to stop and reflect during the implementation phase and assess the contribution that they have experienced to teaching and learning

In the first stage of IWB implementation, Hodge records the evidence of students being subjected to lengthy mat time in front of the IWB. As she explained, the appearance of engagement from the students, could simply be the *“dumbing down”* of student behavior as seen when children are watching television with no interaction.

*“Time on the mat – it was obvious that we have lost the initial “enslavement” which affected us in the first part of the year. Motivation sessions or recording sessions are shorter and routines like handwriting have returned. Small groups use the technology successfully yet other tables of children work away at learning tasks without their attention being constantly diverted back to the front” (Hodge & Anderson, 2007, p. 278)*

After three years of teaching with the IWB technology, the following Case study participant indicated that the use of the IWB as resource tool for inquiry based learning could have an effect, either directly or indirectly on the teacher’s approach to teaching and learning. The following participant explains:

*“It depends on the teacher, so if you are a person that instructs the whole class to do what I have told you and when, or if you are a teacher using the IWB and inquiry-based learning, where the children choose their own questions and research it, teaching the skills and going through the research process with them, it’s student driven. I think with*

*inquiry-based learning which is coming out quite strongly in schools at the moment that will definitely make teaching a lot more student driven.” (Teacher 2, personal communication, March 27 2009)*

The subtle but important change in teaching strategies to student-centered learning and inquiry-based learning could be attributed to the effect that the IWB technology has had on the teachers. Understanding of how technology affects the pedagogy of teaching could be a critical factor in effectual use of the IWB technology. One case study participant explained how the IWB has changed her teaching approach as follows:

*“Teaching wise it’s more stepping back because the kids are getting more active and up there, definitely being more of a facilitator. You are not just in front writing on the board, they are doing it, it’s already there for them to do.” (Teacher 5, personal communication, June 5th, 2009)*

### **5.3.7 Comments on teaching preparation and the IWB learning curve**

This IWB technology appears to be significant in the fact that teachers are happy to use it, even those that are new to the technology. Some of the participants in this research had only experienced the IWB in their classrooms for as little as six months and they were advocates of the technology. This acceptance is explained by a case study participant:

*“In the past you would have a static whiteboard and everything you do you try and put on that whiteboard. Because you have only got the one space and you are always trying to stand there and rub off and put something else on so you are losing a lot of work. Whereas now all I have to do is press button and it flips to a different screen. I have had my old traditional whiteboard moved to the side because I didn’t know if I would still use it. I haven’t touched it...everything I do, I do on the active board and that has been the way since the very first day I got it.” (Teacher 2, personal communication, July 23, 2008)*

Although the IWB functionality can be found elsewhere in a variety of other technologies, the IWB technology incorporates and integrates many existing software and hardware tools smoothly and simultaneously. This convergence of the functionality gives the opportunity for easy storage, retrieval and modification of lesson data. Rapid customization of resources during a class will increase the speed of delivery and administration of materials. A participant explains:

***“The IWB makes [teaching] a lot more exciting but also it saves me a lot of time. I am not good with paper and would put everything on paper and would never be able to find the paper the next year. So you end up redoing the whole thing, whereas now I just click and open the file and change that and it’s done.” (Teacher 2, personal communication, July 23, 2008)***

As discussed by Haldane (2007) when planning a lesson using the IWB, teachers need to take the time to reflect on how best to present their knowledge, when to use the IWB functionality, the usefulness and delivery of resources. Because of the ability to store the entire lesson, the plan and resources in one file (flipchart) on a computer, this gives the teacher an opportunity for undertaking a repeated refinement process (trial runs) of his or her own teaching strategies.

***“When planning an IWB lesson, it can be reflected on and refined prior to first delivery of the topic and prior to subsequent occasions when they cover the same content with a different group. Teachers can also reflect upon, and make optimal use of the scope they have to capture, and subsequently utilize to good effect, rich multimedia resources. The casual interdependency can thus, to a significant extent, be built into the stored content rather than relying solely on the verbal flow during the lesson.” (Haldane, 2007, p. 266)***

If the teacher has only basic ICT skills, the cross over to the functionality of the IWB has been identified as is intuitive. However, it takes time for confidence to build and tools to be explored and utilized to the full advantage. In a preliminary report released in 2009, Haystead and Marzano (2009) examined the effects of an IWB on student achievement. In their conclusion,

they outlined that the following conditions were significant contributing factors in the effective use of the IWB as a tool for student achievement:

- *“A teacher has 10 years or more of teaching experience*
- *A teacher has used the IWB technology for 2 or more years*
- *A teacher uses the IWB technology between 75 and 80 percent of the time in their classroom*
- *A teacher has high confidence in their ability to use the technology.”*

*(Haystead & Marzano, 2009, p. 36)*

It is clear from this Case study project that effective use of the IWB relies on thorough lesson planning by the teacher to ensure the presentation and execution of the class lesson runs smoothly. While the IWB requires an initial understanding of basic computer skills and a certain level of ICT maturity, many of the case study participants agreed that learning curve while intuitive still required time to practice. A case participant explains:

*“It does take time to learn, but I have actually found that learning fun and I don’t pick things up quickly with technology. I am quite confident now and coming from where I started being reluctant and not very confident with computers. I have found it has improved my skills on the computer. I am playing around I am not scared to touch things anymore.” (Teacher 2, personal communication, July 23, 2008)*

However, as discussed by Jewitt, et. al. (2007), teachers need to focus on the topic knowledge, the students learning outcomes and the teaching strategies used to delivery these outcomes, and to move away from prioritizing the IWB functionality within the lesson. The IWB technology should be seen as a resource tool to assist in the lesson delivery and also be seen by the learner as an inconsequential contribution to the learning outcome.



#### **5.4 *Examples and analysis of observed lessons***

In order to assist with the analyzing of the observed lesson, some existing lesson plans were made available to the researcher. However, the majority of the lesson plans had not been updated to include the IWB as a resource during the lesson. The lesson plans did prove helpful in indentifying the context in which the lesson was conducted, but often the lesson observed was only part of a lesson plan submitted to the researcher.

The following ten examples are of lessons observed using the IWB as a resource tool in the classroom. The researcher's field notes were mapped against the lesson structure, and analyzed directly against the IWBFE model (see Figure 7-4) to assess whether the learning opportunities when using the IWB as a tool in the classroom resulted in effective learning for the students.

Further analysis and comparisons were made when the IWB functionality was conducive to the appropriate stage of cognitive development (Woolfolk, 1998) relevant to the age of the students being observed. Notations of preferred learning styles, (Honey & Mumford, 2000) and types of interactivity (Jewitt, et al., 2007) displayed in the lesson were also commented on.

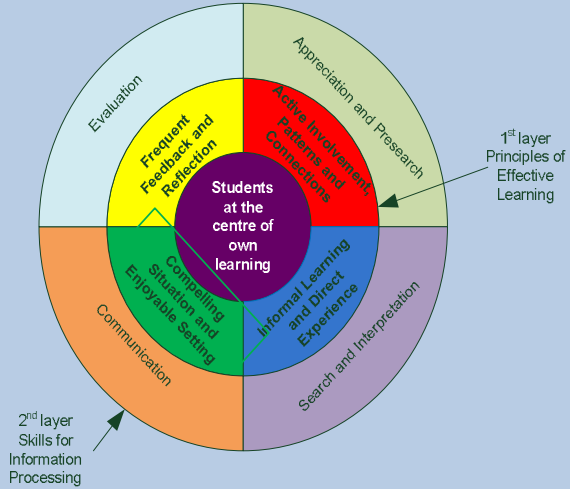
### 5.4.1 Outline of Observed lesson with IWB –Example 1

The following is an analysis of an observed lesson on **Sun and Solar power, part of the Science and Health curriculum learning areas**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Science and Health</b></p> <p><b>Context: Sun and Sun Smart</b></p> <p>Teacher: 1 Children: 22</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Explore and act on issues and questions that link their science learning to their daily living</li> <li>• Build their language and develop their understandings of the many ways the natural world can be represented</li> <li>• Extent their experiences and personal explanations of the natural world through exploration, play, asking questions and discussing simple models</li> <li>• Explore how people's attitudes and values contribute to healthy physical and social environments</li> </ul>	
Structure of observed lesson	Observation Field Notes from researcher	Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	

<p><b>Question:</b> What do we know about the sun? What do we like about the sun?</p>	<p><b>Guided Inquiry Based Learning</b> - brainstorming their existing knowledge. Opportunities for questions and open dialog between students and teachers conversations.  <i>Opportunity for reflector and theorist learning style who prefer to learn from analysis and dialog.</i>  <b>Engagement</b> - All eyes on screen, children attentive. All hands up, eager to collaborate and participate.</p>	<p><b>Compelling Situation and Enjoyable Setting</b>  <b>Student at the centre of their own learning</b></p>
<p><i>Write students ideas on IWB with colored pen (turn into text font?)</i>  <b>Big Idea</b> – the sun is the ultimate source of energy for life on earth</p>	<p>As teacher writes students ideas up on IWB, handwriting is converted into text font; this is an example of <i>technical interactivity</i> for students, where the IWB functionality assists in the visual experience. Opportunity for <b>concrete stage of development (age 7-11 years)</b> to group and classify and collate ideas. Instigate appreciation in the topic</p> <p>While students are participating in whole class activity, their opportunity for <i>conceptual interactivity</i> is stalled, as the teacher has control of what is written on the board and directs flow of conversation and learning outcomes.</p>	<p><b>Patterns and Connections</b>  <i>Opportunity for Appreciation and Pre-search.</i></p>
<p><b>Question:</b> In pairs, discuss ways we could use the sun's energy? What is solar energy?</p>	<p>Students turn to person next door and discuss for a couple of minutes each other's opinion. Opportunity for <b>reflection</b> on existing knowledge (peer to peer assessment and <b>feedback</b>)</p>	<p><b>Frequent Feedback and Reflection</b></p>
<p><i>Watch Brain pop movie (Educational Website contains videos, quizzes, explanations) on Solar energy</i>  <a href="http://www.brainpopjnr.co.uk">www.brainpopjnr.co.uk</a></p>	<p><b>Engagement</b> - Round of cheers from children when Brain pop movie run. All students appear engaged. All eyes on board, no distractions, even when another child comes into the room to deliver a message.</p>	<p><b>Compelling Situation and Enjoyable Setting</b>  <b>Frequent Feedback and Reflection</b></p>

<i>Brain pop Quiz, class discussion and voting</i>	<b>Engagement</b> -Girls miming song to quiz. Students advise technical help for teacher when error on quiz. Opportunity for scaffolding existing knowledge to intended outcomes. (Difficult questions)	<b>Compelling Situation and Enjoyable Setting</b>
<i>View video of cooking with Solar Power from</i> <a href="http://www.science.howstuffworks.com/sun1.htm">www.science.howstuffworks.com/sun1.htm</a>	Opportunity for students to see abstractly the effects of solar energy from the sun. Opportunity for <b>feedback</b> on topic to contribute to the scaffolding of knowledge	<b>Compelling Situation and Enjoyable Setting</b> <b>Frequent Feedback</b>
<i>Use TKI website to design a solar cooking oven, choose cover, installation, lining, try to cook, show temperature gage.</i> Whole Class discussion on materials used to make cooking stove. <a href="http://www.tki.org.nz">www.tki.org.nz</a>	<b>Physical and technical interactivity, Guided Inquiry Based Learning</b> – Students are chosen one by one to come up to the board and collate a solar oven. <i>TKI – Ministry of Education Teacher resource portal.</i> Whole class interactive in dialogue and contributing to discussion. Opportunity for <i>activist and pragmatist preferred learning style to actively construct knowledge.</i>	<b>Active Participation, Patterns and Connections</b> <i>Opportunity for Student at the centre of their own learning</i>
Group work, design a solar cooking oven.	<b>Active participation and Guided Inquiry Based Learning</b> -Students divided into groups and working collectively with the task outlined on the IWB for constant reference. Consistent patterns and connections made of topic. Opportunity for <i>theorist preferred learning style as allows students to think through step by step how to design a solar oven.</i>  <b>Physical classroom and technical Issues</b> - Text and colors used on the IWB difficult to read from back of class. Some text written on board with pen, misinterpreted by OCR reader, have to be corrected	<b>Active Participation, Patterns and Connections</b> <i>Opportunity for Student at the centre of their own learning.</i> <i>Opportunity for Pre-search, Search and Interpretation</i>

Figure 5-6 Observed lesson – Solar Power

#### **5.4.2 Summary of observed lesson – Example 1**

When observing the above lesson, there were clear engagement and motivation signals from the children such as vocal excitement, all hands up to participate in discussion, all faces and eyes on IWB. Most of the boys were up the front and eager to participate. Throughout the lesson, there was an opportunity for the students to make connections and patterns, whilst getting timely feedback both from the teacher and from the IWB via its functionality. By using the IWB to introduce the topic, the student's attention was gained and the opportunity for the students' first experience of the topic to be enhanced. There was a clear observation of an identified useful IWB functionality. The technical setting up of a solar oven could be shown visually and in modular sections, saving the time taken in physically constructing the oven (Beauchamp & Parkinson, 2005).

The lesson did not contribute to informal learning outside of the classroom, however, the intention was for the students to manually construct an oven over the term and actually cook an egg or melt a marshmallow, which will ensure the students have direct experience in making and using the solar oven. The lesson did not allow for students to practice any information processing skills other than that of appreciation, and possible opportunities for search and interpretation, when the students were active in their learning, creating their own questions, where they had to access, reflect and create a solar oven design (Callahan & Switzer, 2004).

Although the questions asked by the teacher were open, very few student-directed opportunities were permitted. The teacher often directed the content flow and selected the students to answer the questions. The only time the students were able to use the IWB was when they were asked to come up one at a time to select answers on the quiz and design the solar oven. Until the students were able to get into groups and design their own solar ovens on paper, the IWB technology was used for nearly one hour and the children were seated on the mat for all of this time. There were no distractions or behavior issues observed.

### 5.4.3 Outline of Observed lesson with IWB –Example 2

The following is an analysis of an observed lesson on **recounting a story, which is part of the English curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- English</b></p> <p><b>Context: Recount</b></p> <p>Teacher: 1 Student Teacher: 1 Children: 23</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Recount events in a range of authentic contexts</li> <li>• Identify and express meaning in written texts</li> <li>• Write factual accounts and express personal viewpoints in a range of authentic contexts sequencing ideas logically</li> </ul>	
<b>Structure of observed lesson</b>	<b>Observation Field Notes from researcher</b>	<b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	<p>1<sup>st</sup> layer Principles of Effective Learning</p> <p>2<sup>nd</sup> layer Skills for Information Processing</p>
<p><b>Question:</b> What is a recount; discuss key words when writing a recount story.</p>	<p><b>Guided Inquiry Based Learning</b> – Students turn to person next door and discuss for a couple of minutes each other’s opinion on what is a recount? Opportunities for dialog between students and teachers.</p>	<p><b>Student at the centre of own learning (</b></p>



<i>Short story recount brought up on IWB, teacher reads out to class</i>	<b>Engagement</b> – Visual stimulation. Whilst teacher is reading, the visuals are supporting the dialog that is happening amongst students and teacher.	<b>Compelling Situation and Enjoyable Setting</b>
<b>Questions:</b> Discuss order of events, a plan of events in chronological order.	Whole class activity. Teacher itemizes suggestions on board. Many hands up. All eyes on IWB. Opportunity for <b>conceptual interactivity</b> with co-creation of outcomes.  Some text written on board with pen, misinterpreted by OCR reader, have to be corrected manually	<b>Patterns and Connections</b>
<i>Use a Witness Account video, "Point of view" witness account of a bike crash, narrated by a child from NZ educational teaching resource website <a href="http://www.tki.org.nz">www.tki.org.nz</a></i>	<b>Engagement</b> - Absolute silence, all watching. Appears to be keen attention paid when hearing child's voice on video. <i>Opportunity for reflector and theorist preferred learning style</i> types where the student has the change to watch and think.	<b>Compelling Situation and Enjoyable Setting</b>
<i>Using text IWB, students highlight video script with pen, the telling words, who, what, and when.</i>	<b>Physical and Technical Interactivity</b> - Whole class eager to participate. Each student picks the next person to come up. A reinforcement of <b>patterns and connections</b> . <i>Opportunity for Pragmatist and Activist preferred learning style types</i> because the activity is problem based and active.	<b>Active Participation, Patterns and Connections</b>

Hard copy of story given out to each child. Child works individually on copy to highlight <i>conjunctions and time words, verbs written in past tense</i> on their own copy. <i>Time up chime on Active board announces allocated time to do this task.</i>	This activity was previously viewed video and contributed to the identification of word patterns previously seen and cognitive connections made	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Pre-search.</i>
<i>Example of answers displayed on IWB</i>	Students self mark own work against example on board, Peer feedback. Group at table discussed correct answers and why.	<b>Active Participation, Patterns and Connections</b> <b>Frequent Feedback and Reflection</b>
Class convenes. Discusses important features of recounts.	Opportunity to reflect on lesson, make connections and think deeply  <b>Physical classroom and technical Issues</b> - Text and colors used on the IWB difficult to read from back of class.	<b>Frequent Feedback and Reflection</b>

Figure 5-7 Observed Lesson – Recounting a Story

#### 5.4.4 Summary of observed lesson – Example 2

At the start of the lesson, there were obvious signs of excitement and engagement when Teacher suggested using the IWB technology for this lesson. The delivery of the lesson was seamless. Assisting in the flow of information and supporting the verbal dialog from the teacher on the identification of words used in recount writing were the rich multimedia symbols of the IWB functionality (Haldane, 2007). There were positive expressions and interactions from the children.

The recount video narrated by a child appeared to be particularly enticing for the students viewing the video contributing to a compelling situation for effective learning. The introduction repeated a number of opportunities for active involvement, patterns and connections and reflection on the topic being learnt. The lesson was broken into sections which appeared to maintain the motivation for the topic, incorporating physical interactivity with conceptual interactivity equally (Jewitt, et al., 2007). The IWB was used for the first 20 minutes of the lesson, and then the students moved to work on tasks at their tables individually. Once finished, they peer-assessed each other's work at the table which gave opportunity for small group collaboration and fostered exploratory talk amongst the group (Burns & Myhill, 2004). At the end of the lesson, the whole class convened for an opportunity for reflection, an important part of the lasting cognitive connections required in effective learning situations.(Callahan & Switzer, 2004)

Whilst the lesson appeared to have a number of active opportunities, the requirements were teacher-directed and had limited opportunities for student-centered learning. As the objectives of this lesson are based in content and the identification of time words, conjunctions and verbs, the structure of the lesson appeared managed and suitable to the students' stage of development, in particular, the opportunity to classify and revise the story content with the appropriate use of language.

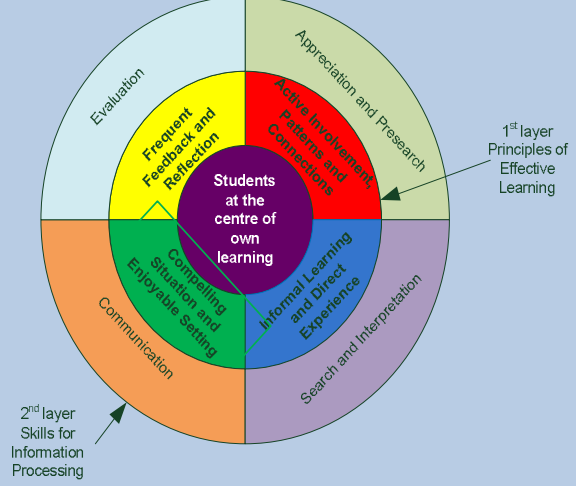
### 5.4.5 Outline of Observed lesson with IWB –Example 3

The following is an analysis of observed lesson on **metaphors and similes, which is part of the English and Language curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:-</b>  <b>Written Language, Poetic Writing</b></p> <p><b>Context: Metaphors and Similes</b>  Teacher: 1  Children: 17</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Write on a variety of topics, beginning to shape ideas (level one)</li> <li>• Write on a variety of topics, shaping ideas in a number of genres, such as letters, poems and narrative and making choices in language and form.</li> </ul>	
Structure of observed lesson	Observation Field Notes from researcher	Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	

<p><b>Question:</b> Describe your Pet</p> <p><i>Instructions on the IWB, to get into pairs and discuss a pet, using five adjectives.</i></p>	<p><b>Guided Inquiry Based Learning</b> – Students turn to person next door and discuss for a couple of minutes each other’s pets using 5 adjectives. Opportunity for reflection and connections made to existing knowledge</p>	<p><b>Patterns and Connections. Reflection</b></p>
<p><i>Show examples of Joy Cowley story “Day of rain/wind/snow.” Discuss what metaphors and similes are.</i></p>	<p><b>Engagement</b> – happy, quiet and eager to watch video</p>	<p><b>Compelling Situation and Enjoyable Setting</b></p>
<p><i>Write a poem about their pet together on IWB using adjectives, metaphors or similes</i></p>	<p>Whole class co-constructs a poem. Teacher writes up on IWB. Opportunity for <i>conceptual interactivity</i>, where the students are exploring and constructing content on the IWB together.</p>	<p><b>Active Participation, Patterns and Connections</b></p>
<p><b>IWB Video</b> on Metaphors and Similes and their use in making your poem exciting. <a href="http://www.brainpopjnr.com">www.brainpopjnr.com</a></p>	<p><b>Engagement</b> – opportunity reflection and cognitive connections to be made on current topic.</p>	<p><b>Compelling Situation and Enjoyable Setting. Frequent Feedback and Reflection</b></p>
<p><b>IWB Quiz</b> - pull an image of a verb, out of the shelves place in correct order.</p>	<p><b>Physical and Technical Interactivity</b> - Whole class eager to participate, many hands up. All eyes on board. Each student comes up to have a turn then picks another student to follow.</p>	<p><b>Compelling Situation and Enjoyable Setting</b> <b>Active Participation, Patterns and Connections</b></p>

<b>Group work. Activity on metaphors and similes.</b>	<p>Students broken into Groups</p> <ul style="list-style-type: none"> <li>• 1st group work at desks on follow-up worksheet</li> <li>• 2nd group works on the floor with the teacher</li> <li>• 3rd group works at the IWB, continuing with IWB Quiz. Collaborative <b>Group work</b> - Students at IWB, select competence level of game to play, easy, medium or hard. One student acts as the teacher and picks students to participate. No issues of non compliance. Students select IWB options fun and test the environment. <b>Physical and Technical interactivity</b> – opportunity for students to experience and use multimedia resource.</li> </ul>	<p><i>Opportunity for Student at the centre of their own learning</i> <b>Frequent Feedback and Reflection</b></p>
<b>Whole class convenes. Question:</b> - What are you most pleased with today. What helped you today? What did you find difficult	<p>Opportunity for class to share and collaborate on lesson taken. Cognitive connections to be made for lasting learning opportunities</p>	<p><b>Reflection</b></p>

**Figure 5-8 Observed Lesson – Metaphors & Similes**

### **5.4.6 Summary of observed lesson – Example 3**

This lesson used a variety of IWB functionality; flipcharts, video, audio clips all contributing to an engaged learning environment. The teaching approach adopted in this lesson was seen as a contributing factor in the classroom atmosphere. The use of language and actions provided a gentle, quiet and supportive setting for effective learning (Fielden, 1995; Jensen, 2008).

Within this lesson, there was a clear identification of effective learning, using the IWB as a tool for conceptual interactivity. This was seen where the students and teacher collaboratively constructed a poem on the IWB using metaphors and similes. Students were collectively at the centre of their own learning, and the lesson content was a result of teacher/student/technology interaction.(Jewitt, et al., 2007)

However, in whole class work, the teacher did direct the majority of the social discourse closely and tended to pick the same people to answer the questions. It is this dominance and imbalance of contributions amongst a group that have been criticized in studies of patterns of whole class interactions (Jewitt, et al., 2007).



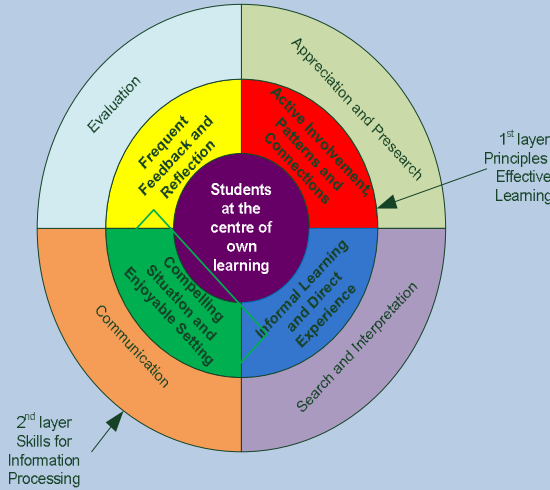
#### 5.4.7 Outline of Observed lesson with IWB –Example 4

The following is an analysis of an observed lesson on **counting in twos, fives and tens, which is part of the Mathematics curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Mathematics</b></p> <p><b>Context: Counting in twos, fives and tens.</b> Teacher: 1 Children: 18</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Solve Multiplication problems using skip counting in twos fives and tens</li> <li>• Devise and use problem solving strategies to explore situations mathematically.</li> </ul>	
<p><b>Structure of observed lesson</b></p>	<p><b>Observation Field Notes from researcher</b></p>	<p><b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b></p>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	
<p><i>IWB displays WALT – We are learning to - skip count and multiply my 2s, 5s, 10s and 3 times table</i></p>	<p>The WALT is reads out in a student's pre recorded voice. All students immediately <b>engaged</b>.</p>	<p><b>Compelling Situation and Enjoyable Setting</b></p>

<p><i>IWB video –Video (6 minutes) showing multiplication and skip counting.</i></p> <p><a href="http://www.brainpop.com">www.brainpop.com</a></p>	<p><b>Engagement</b> – quiet and attentive. Connections are made with topic visually. Opportunity for reflector and theorist preferred learning styles to watch and think about topic</p>	<p><b>Compelling Situation and Enjoyable Setting</b> <b>Frequent Feedback</b></p>
<p>Question - What is a multiple of 10?</p>	<p><b>Guided inquiry based learning</b> - Students discuss with neighbor. Then as a whole class. Opportunity for <b>patterns and connections</b> to be made with topic.</p>	<p><b>Patterns and Connections</b></p>
<p><i>IWB Flip chart on multiples of 10.</i></p>	<p><b>Physical and Technical interactivity.</b> Selected student activate multiplication symbols on board, and then chooses next participant. IWB Technology confirms and feeds back with sounds for confirm or deny</p>	<p><b>Active Participation. Compelling Situation and Enjoyable Setting. Frequent Feedback</b></p>
<p>Group Work, Activities handed out.</p>	<p>Students are broken into groups</p> <ul style="list-style-type: none"> <li>1<sup>st</sup> group works on multiplication Flipchart activity on board – Teacher chooses one student to act as teacher to direct game and select students to participate. <b>Technical issue arises, students sort it out themselves.</b> Silly selections on IWB for fun. Conflict managed by acting teacher/student. <b>Physical and Technical interactivity</b> – opportunity for students to experience and use multimedia resource.</li> <li>Two groups given worksheets at desks. Mathematics puzzles and games.</li> <li>One group with teacher on floor working on small group activity. Counting games, Snakes and ladders.</li> </ul>	<p><b>Active Participation, Patterns and Connections.</b></p> <p><i>Opportunity for Student at the centre of their own learning</i></p>

<p>Class convenes to recap lesson. Students asked to identify</p> <ul style="list-style-type: none"> <li>• Something you have learned</li> <li>• Something you have enjoyed</li> </ul> <p>Discuss with neighbor Teacher selects some students to share with class</p>	<p>Overall, students <b>reflect</b> and identify ways to skip count, however one student expressed they did not know. At this point, peers identify a counting solution for this student.</p>	<p><b>Reflection</b></p>
<p><i>On IWB Learning mountain, students identify how they feel they have learned this lesson. Well, medium, not so well.</i></p>	<p>Students identify learning maximum on continuum. Students mostly in middle of continuum, and appear to be quite honest about the level of learning obtained. Indication to teacher how the student feels about the lesson.</p>	<p><b>Frequent Feedback and Reflection</b></p>

**Figure 5-9 Observed Lesson - Counting**

#### **5.4.8 Summary of observed lesson – Example 4**

This lesson used the IWB functionality consistently contributed to observed engagement through the use of multimedia. The lesson structure also showed opportunities for feedback and reflection either from the IWB or from the dialog around the learning outcomes. The lesson showed the effective use of weaving the Teachers knowledge (dialog), the IWB knowledge (videos and flipcharts) with student dialog offers the student the opportunity to link together patterns and connections to form new threads of knowledge (Haldane, 2007).

The most effective interactive opportunity was the group of students who worked independently of the teacher using the IWB technology. The group worked collaboratively, choosing their level of difficulty in the activity, taking turns to interact physically with the IWB, collectively solving technical issues and conflict. However, each learning opportunity was managed closely by the teacher, which resulted in a selected skill counting strategy being used, whereas, if the student was at the centre of their own learning the number of strategies may have expanded.

#### 5.4.9 Outline of Observed lesson with IWB –Example 5

The following is an analysis of an observed lesson on **reading events in the correct order, which is part of the Reading curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Reading</b></p> <p><b>Context: Events in the correct order</b> Teacher: 1 Children: 20</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Select and read for enjoyment and information, a range of written texts, making confident use of semantic, syntactic, visual and grapho-phonetic cues and the conventions of print, and predicting and self correcting while clarifying ideas.</li> <li>• Respond to language, meanings and ideas in different texts, relating them to personal experience.</li> </ul>	
<b>Structure of observed lesson</b>	<b>Observation Field Notes from researcher</b>	<b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	
<p><i>IWB video of a short story of boy on bike, his journey and mishap – <a href="http://www.tki.org.nz">www.tki.org.nz</a></i></p>	<p><b>Engagement</b> – quiet and attentive. <b>Multimedia</b> used to foster interest in the topic.</p>	<p><b>Compelling Situation and Enjoyable Setting</b> <b>Opportunity for Appreciation.</b></p>

<i>IWB quiz children select from list, order of events of story just watched using pen</i>	<b>Physical and Technical interactivity.</b> Teacher facilitates. Students pull events into order, if correct IWB makes a sound. Otherwise flicks back. Opportunity for <i>interpretation</i> of video and <b>cognitive</b> connections to be made.	<b>Active Participation, Patterns and Connections</b> <i>Opportunity for Interpretation.</i>
<i>On IWB students come up and write on board words that describe the character of boy</i> <b>Question:</b> How could mishap be avoided?	<b>Physical and Technical interactivity.</b> Teacher facilitates. Student writes word on IWB with pen, underline if not sure of spelling. Class correct together. Class discusses meaning of identified words. Opportunity for <b>conceptual interactivity</b> where content is created together. Class discussion on alternatives to avoiding the mishap. <i>Opportunity for pragmatist and activist preferred learning styles</i> to apply learning into practice.	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Student at the centre of their own learning</i>
<i>IWB shows a map of boy's bike journey. What could be on a map?</i>	Students suggest options, roads, valleys etc. <i>Opportunity for theorist preferred learning style type</i> to think things through. Students are able to communicate and co-construct their current learning on the map.	<i>Opportunity for Student at the centre of their own learning</i> <b>Opportunity for Communication.</b>
Teacher reads a story to children from book.	Whilst this story being read, children work on hard copy and creation of a map at their tables. All children working quietly, while listening. <i>Opportunity for all preferred learning styles to apply learning actively.</i>	<b>Frequent Feedback and Reflection</b>
Class convenes. Back on Map IWB, more items added to map on	<b>Physical and technical interactivity.</b> Children picked to drag parts onto map. All hands up, very eager to have a go. Very elaborate Map results.	<b>Patterns and Connections. Reflection</b>

**Figure 5-10 Observed Lesson – Recounting an event in order**

#### **5.4.10 Summary of observed lesson – Example 5**

The flow of this lesson was seamless. As discussed by many of the case study participants, the IWB technology affords the teacher the tools to maintain the momentum of learning far more than traditional methods of teaching (Haldane, 2007). While the teacher facilitated this lesson closely, the students had a very active part to play in the outcomes. They decided the layout of the maps and, by describing the character in the story, they were able to advise their ideas and direct their own learning.

All preferred learning style activities were met, physically hands-on for the activists, applying content for the pragmatists, working through the content for the theorists, and time to consolidate the learning content for the reflectors.

There was an observed technical issue with some of the images on the IWB when designing a map as a whole class activity. The students corrected the teacher in how to fix the image. Some of the text was difficult to see from the back of the classroom.



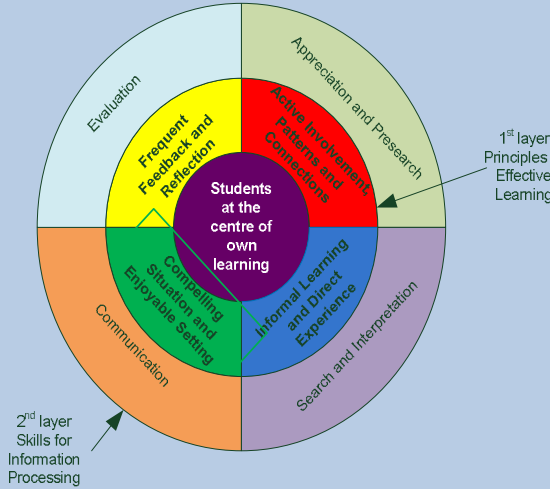
#### 5.4.11 Outline of Observed lesson with IWB –Example 6

The following is an analysis of an observed **spelling lesson on OU and OW, which is part of the Reading, Spelling and Comprehension curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Reading, Spelling and Comprehension</b></p> <p><b>Context: Spelling OU and OW</b> Teacher: 1 Children: 21</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Revise the main ways of writing the /ou/ sound, which are &lt;ou&gt; and &lt;ow&gt;.</li> <li>• Memorize which words take each one.</li> </ul>	
<p><b>Structure of observed lesson</b></p>	<p><b>Observation Field Notes from researcher</b></p>	<p><b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b></p>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	
<p><b>Question:</b> What are the main ways of writing the /ou/ sound, which are &lt;ou&gt;. and &lt;ow&gt;.</p>	<p><b>Engagement</b> - Teacher suggests we use the IWB for lesson today. Class responds with round of cheering.</p>	

IWB show examples of words with <OU> and <OW>. Examples of the same word spelt correctly and miss-spelt.	<b>Physical and technical interactivity.</b> Teacher facilitates children to suggest and come up and correct spelling. If the child spells correctly, an animal sound is heard.	<b>Compelling Situation and Enjoyable Setting</b> <b>Active Participation, Patterns and Connections</b> <i>Opportunity for Appreciation and Pre-search</i>
IWB shows examples of sentences with missing words. From a spelling list on the side, fill in <OU> and <OW> word examples.	<b>Physical and technical interactivity.</b> Teacher facilitates, children to select correct word to insert into sentence. <b>Technical issue with highlighter, student advises teacher of solution.</b>	<b>Active Participation, Patterns and Connections</b> <i>Opportunity for Appreciation and Pre-search</i>
Using BBC teachers resource centre, select spelling game. Words dragged onto balloon. <a href="http://www.bbc.co.uk/schools">www.bbc.co.uk/schools</a> •	<b>Physical and technical interactivity.</b> One teacher picks a student to come up a drag word, student then picks next student take a turn. Students ask for most difficult level of game to play.	<b>Active Participation, Patterns and Connections</b>
Class moves to small group work.	<ul style="list-style-type: none"> <li>• 2 groups doing spelling worksheets at tables.</li> <li>• 1 group works on activity with teacher on floor.</li> <li>• 1 group works at IWB, creating flipchart with words and pre recorded sounds. The group working at the IWB create their own flipchart. Inserting their pre-recorded voices and images of themselves. Group works well collaboratively. <b>Physical and Technical interactivity</b> – opportunity for students to experience and use multimedia resource.</li> </ul> <p><b>Physical classroom and technical Issues</b> – Technical issues quickly solved by students. Text and colors used on the IWB difficult to read from back of class</p>	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Student at the centre of their own learning</i> <i>Opportunity for Search, interpretation and Communication</i>

Figure 5-11 Observed Lesson - Spelling

#### **5.4.12 Summary of observed lesson – Example 6**

In the whole class work, students appeared to be very active in this lesson, but limited in their interactivity. Whilst the teacher requested the student's active participation, the opportunity for student-centered learning and exploration was limited to the pre-defined design of the text on the IWB.

The small group work using the IWB functionality allowed students a more dynamic and effective learning opportunity (Jewitt, et al., 2007). Students worked on the IWB to co-create a flipchart on Spelling with OU and OW, the students selected their theme, images, sound and created content together in a very “student at the centre of their own learning” environment. In carrying out this activity, the students also were required to search, interpret and communicate their ideas, which was valuable practice in information processing skills.

There were small technical issues with the IWB toolbar, and the students quickly worked out solutions. In addition, from the back of the room some of the text and font colors on the IWB were difficult to read.

#### 5.4.13 Outline of Observed lesson with IWB –Example 7

The following is an analysis on an observed lesson on **what is the best picture to tell a story, which is part of the English, Reading and Comprehension curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- English</b></p> <p><b>Context: What is the best picture to tell a story?</b> Teacher: 1 Children: 24</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Select and read independently, for enjoyment and information, different contemporary and historical texts, integrating reading processes with ease.</li> <li>• Discuss language, meanings and ideas in a range of texts, relating their understanding to person experiences and other texts.</li> </ul>	
<b>Structure of observed lesson</b>	<b>Observation Field Notes from researcher</b>	<b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	
<p><i>IWB Video. From rocksfordrockopera.com story on the Cocklebur Ick.</i></p>	<p><b>Engagement.</b> Students attentive during story, 20mins long. The story content, music and images were spellbinding.</p>	<p><b>Compelling Situation and Enjoyable Setting</b></p>

Identify some questions about the story?	Teacher facilitates discussion about story comprehension with students. Students to discuss with neighbour their understanding of what happened in the story.	<b>Reflection</b>
<i>IWB brings up screen captures of images from the story.</i> Teacher facilitates, what is happening in the picture, asks students does it match the story.	Students collectively gave their opinions. Opportunity to co-create learning content. Opportunity for <b>conceptual interactivity</b> where the outcome is directed by the students.	<b>Patterns and Connections.</b> <i>Opportunity for Student at the centre of their own learning</i>
<i>Using IWB flipchart, teacher discusses the way to map a story, main points and key features,</i>	Students help collate main events from memory, verbally. Teacher writes ideas on the board.	<b>Patterns and Connections</b> <i>Opportunity for Student at the centre of their own learning</i> <i>Opportunity for interpretation</i>
Students break into groups and using a worksheet, create a story map of Rocksford rock opera.	Students work quietly at tables, teacher circulates to help.	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Search, interpretation, and communication.</i>

Figure 5-12 Observed Lesson – Best Picture to tell a story

#### 5.4.14 Summary of observed lesson – Example 7

This lesson was very engaging for students and observer. A simple but effective lesson, where the IWB technology was used effectively as a resource, but not the focus of the lesson plan. The content of the story was unique, inventive and interesting. The teacher had obtained the story from the internet. Using the IWB functionality, the teacher was able to select frames from video, crop and use in a storyboard. This opportunity to select and focus the students attention on the relevant content, then support the images with a discussion was seen as an opportunity to build deeper knowledge about the topic (Finger, et al., 2007; Haldane, 2007).

In this lesson, the teacher used very open questions in whole class interactions, therefore allowing the students to offer opinions and direct their own learning in co-creating content. A good opportunity for students to direct their own learning. Although the video content was fictional, it was very inspiring and had some environmental messages that the students identified with, as this was another current topic that they were involved with that term.

Students practiced some search, interpretation and communication skills when collating and looking for events within the story, and then interpreting them into a story map.



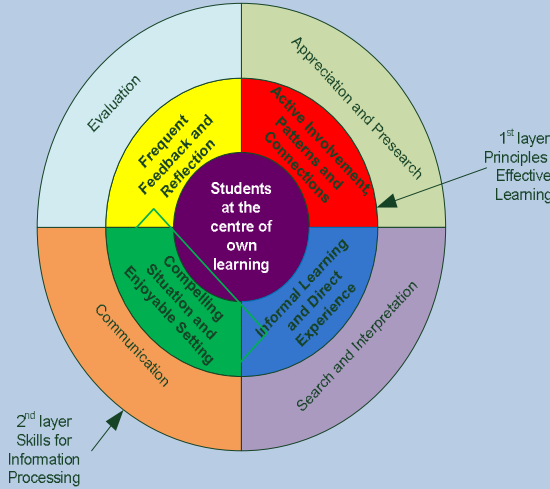
#### 5.4.15 Outline of Observed lesson with IWB –Example 8

The following is an analysis of an observed lesson on **fractions, which is part of the Numeracy curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:-</b> <b>Numeracy</b></p> <p><b>Context: Fractions</b> Teacher: 1 Children: 22</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Devise and use problem solving strategies to explore situations mathematically.</li> <li>• Use equipment appropriately when exploring mathematical ideas.</li> <li>• Classify objects. Devise and follow a set of instructions to carry out a mathematical activity.</li> <li>• Record and talk about the results of mathematical exploration</li> </ul>	
<p><b>Structure of observed lesson</b></p>	<p><b>Observation Field Notes from researcher</b></p>	<p><b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b></p>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	

<p><i>Using IWB, teacher introduces Fractions using revel tool to move box showing images of quarters, thirds, half's, wholes etc and revel fraction.</i></p> <p>•</p>	<p><b>Engagement</b> - All eyes on screen, children attentive. All hands up, eager to collaborate and participate. Teacher facilitates competition game between two selected students, the first to identify the fraction before revel. Boys all appear excited.</p>	<p><b>Compelling Situation and Enjoyable Setting</b></p>
<p><i>IWB flipchart from TKI teacher resource website uses a cake to identify fractions. Move pictures; write answers on IWB with pen. Uses multiplication to find a fraction of a set. Share out candles onto cake to represent fraction.</i></p> <p><a href="http://www.tki.org.nz">www.tki.org.nz</a></p>	<p><b>Physical and Technical interactivity.</b> Teacher facilitates, students come up to the IWB and then select next student. <i>Opportunity for Activists and Pragmatists preferred learning styles to apply learning actively.</i></p>	<p><b>Active Participation, Patterns and Connections. Frequent Feedback and Reflection</b></p>
<p>Class moves to small group work.</p>	<ul style="list-style-type: none"> <li>• One group at IWB and use multiplication dice game. Students at select medium level of difficulty, collective agreement on this. Once finished, with everyone taking turns and working collaboratively, then group decides to challenge themselves by selected hardest level of game to play. <b>Physical and Technical interactivity</b> – opportunity for students to experience and use multimedia resource.</li> <li>• One group on three computers in room working on mathematics activities (two per computer).</li> <li>• Two groups work on worksheets at tables.</li> </ul>	<p><b>Active Participation, Patterns and Connections. Opportunity for Student at the centre of their own learning</b></p>

Figure 5-13 Observed Lesson - Fractions

#### **5.4.16 Summary of observed lesson – Example 8**

While the teacher facilitated this lesson, the students had a strong collective presence in directing the games. They were active, engaged and work well throughout the lesson. The combination of symbols, numbers and images support the class room dialog amongst teacher and students to establish understanding and reinforce content contributing to an effective learning opportunity (Haldane, 2007).

The opportunity for the group to work on the IWB independently shows how they will collaborative make decisions together, take turns to use the pen or the wand and respect each other's choices without the teacher as facilitator. However, again the outcomes of the interaction were pre-defined, therefore the opportunity for exploration and creation of content was limited.

The lesson displayed opportunities for activist and pragmatist preferred learning styles, where they were able physically participate and use the lesson content to engage in the learning process.

#### 5.4.17 Outline of Observed lesson with IWB –Example 9

The following is an analysis of an observed lesson on the **food pyramid, which is part of the Health curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Health</b></p> <p><b>Context: Food Pyramid</b> Teacher: 1 Children: 20</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>Identify the layers of the Food pyramid</li> <li>Identify what types of food make a balanced meal.</li> </ul>	
<b>Structure of observed lesson</b>	<b>Observation Field Notes from researcher</b>	<b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li><i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li><i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	
<p><i>IWB Video. Story on eating and food. Video shows food pyramid. <a href="http://www.tki.org.nz">www.tki.org.nz</a></i></p>	<p><b>Engagement</b> - All eyes on screen, students attentive</p>	<p><b>Compelling Situation and Enjoyable Setting</b></p>

Teacher discusses video with students	<p><b>Guided Inquiry Based Learning</b> - brainstorming their existing knowledge. Students discuss with neighbours what they think of the video. Opportunities for questions, between students and teachers conversations. <i>Opportunity for reflector and theorist learning style to think, reflect and analyze learning content.</i></p> <p>Request over loud speaker to reboot Network.</p>	<b>Reflection</b>
<i>IWB Game. Brain pop teacher resource game, place food on continuum of good to bad food. <a href="http://www.brainpopjnr.co.uk">www.brainpopjnr.co.uk</a></i>	<b>Physical and Technical interactivity</b> allowing for synaptic connections to be made with current knowledge of lesson. A student is selected to come up to the board and move foot onto continuum. Student peer selects next participant.	<b>Active Participation, Patterns and Connections</b>
<i>IWB Flipchart. Make a food pyramid. Move pictures of food into Food groups.</i>	<b>Physical and Technical interactivity.</b> Students take turns to come up to the IWB and move images onto food pyramid. Sounds for correct/incorrect foods placed in pyramid. Ideas and suggestions from rest of class if incorrect placement. <i>Opportunity for Activists and Pragmatist preferred learning styles</i> to learning physically.	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Student at the centre of their own learning</i>
Small group work	<ul style="list-style-type: none"> <li>1st group, use IWB game to design a sandwich. Drag pictures of food library onto sandwich. Group works collaboratively on the design of a sandwich. Foods can be selected from book of foods with categories of types of food. Many comments from students about what they usually have in their lunch sandwiches, some comments on what they would like to have in sandwiches. <b>Physical and Technical interactivity</b> – opportunity for students to experience and use multimedia resource. Also, an opportunity for students to relate to a real and <b>direct learning</b> experience,</li> </ul>	<b>Active Participation, Patterns and Connections.</b> <i>Opportunity for Student at the centre of their own learning.</i> <b>Opportunity for Direct Experience</b>

	<p>sandwich making.</p> <ul style="list-style-type: none"> <li>• 2nd group work with teacher on floor.</li> <li>• 3rd and 4th group work on food pyramid worksheets</li> </ul> <p><b>Technical Issues</b> – Request from School administrators to reboot school servers as a result of networking issue. A break in the lesson to do so.</p>	
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**Figure 5-14 Observed Lesson – Food Pyramid**

#### **5.4.18 Summary of observed lesson – Example 9**

The use of the multimedia resources contributed to the engaged group of students in this topic. The active participation from the students when building the food pyramid saw some students participating in co-creating their learning content; contributing to the directing their own learning.

The small group work on the IWB appeared to work collaboratively, with peers assessing each other's choices when building the a healthy sandwich. This opportunity for the students to discuss and identify with a real and direct experience could be seen as a scaffolding of current knowledge. Disagreements were worked out within the group without teacher facilitation. The IWB acted as the facilitator, restricting selections and using sound for corrections in the game.



#### 5.4.19 Outline of Observed lesson with IWB –Example 10

The following is an analysis of an observed lesson on the **proof reading and editing, which is part of the Writing curriculum learning area**. The analysis shows the lesson structure, the field notes collected during the observation and identification of when the IWB functionality or the lesson content aligns with the essential elements identified for quality education as defined in the *IWBFQE model* (see below):

- *Students at the centre of their own learning* - directing, problem solving, critical and reflective thinking
- *Principles of effective learning* - active involvement, patterns and connections, informal learning and direct experience, reflection, compelling situation and enjoyable setting, frequent feedback and reflection
- *Information processing skills* - appreciation and pre-search, search and interpretation, communication and evaluation.

Assisting in the identification and analysis of effective learning are other theoretical learning frameworks:

- *Stages of Cognitive Development*, identification of opportunities relevant to the observed children's age: Concrete Operational Stage (Age 7-11) which identifies the important processes of this stage being seriating, classification, and reversibility of actual (concrete) objects and not hypothetical tasks (Woolfolk, 1998)
- *Preferred learning styles*, identification of the student's preferred style of learning; Active, Reflector, Theorist or Pragmatist (Honey & Mumford, 2000)
- *Physical, technical and conceptual interactivity*, identification of opportunities for student activity physically, or with the technology functionality and conceptually in the construction of concepts and ideas (Jewitt, et al., 2007).

<p><b>Curriculum Area:- Writing</b></p> <p><b>Context: Proof reading and Editing</b></p> <p>Teacher: 1 Children: 23</p>	<p><b>Achievement Objectives</b></p> <ul style="list-style-type: none"> <li>• Practice proof reading a number of text examples and editing</li> <li>• Correct spelling, punctuation, and missing words.</li> </ul>	
<p><b>Structure of observed lesson</b></p>	<p><b>Observation Field Notes from researcher</b></p>	<p><b>Learning Theory -Identification of lesson content with Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)</b></p>
<p><i>Orange text</i> – IWB functionality used as part of the lesson plan</p>	<ul style="list-style-type: none"> <li>• <i>Blue text</i> – observed research data and reflection on positive example of proposed effective teaching and learning opportunities</li> <li>• <i>Red text</i> – observed research data on unsuccessful use of IWB for teaching and learning.</li> </ul>	

<i>IWB text document shows story which is full of miss-spelt words, incorrect punctuation and missing words.</i>	<b>Engagement</b> - Students attentive. Teacher facilitates. Students use wand to underline miss-spelt words. Students add in missing words. Students use wand to correct punctuation	<b>Compelling Situation and Enjoyable Setting. Active Participation.</b>
<i>IWB shows another story. Students replace adjectives with more exciting ones.</i>	<b>Physical and Technical interactivity.</b> Teacher facilitates. Students use wand to highlight and replace words. All hands up, eager to collaborate and participate.	<b>Active Participation.</b>
All children work on worksheet on existing piece of writing to proofread and edit at desks.	Students work quietly and studiously. Once finished they brought the worksheet up to the teacher for feedback.  <b>Physical classroom and technical Issues</b> - Text and colors (yellow) used on the IWB difficult to read from back of class. Announcement via loudspeaker to reboot school network. Break in the lesson whilst this is done.	<b>Active Participation, Patterns and Connections. Reflection</b>

Figure 5-15 Observed Lesson – Proof Reading and Editing

#### 5.4.20 Summary of Observed lesson – Example 10

This lesson was an example of the IWB being used as an elaborate whiteboard. The IWB showed the text as a document, with no images or sound. The only feedback to the student was from the teacher by way of verbal dialog. Because the only functionality that the IWB exhibited was text, the highlighting and replacing of words, and the opportunity for students to experience some transient media, such as images or audio was nonexistent therefore the opportunity to re-enforce the stable text, the opportunity for a deeper learning experience was limited (Haldane, 2007).

Although the students were physically active in coming up to the board and using the pen, the activity was routine, and held little opportunity for a deeper cognitive learning experience due to the predetermined learning outcomes. When the students worked on the worksheet, editing the story individually, there was the opportunity for patterns, connections and reflections to be made, in order to make meaning out of the lesson as a whole.

From the back of the room, it was difficult to see the text on the IWB, particularly as the text was yellow on a white background, again not using the IWB functionality effectively. This lesson offered no opportunities for informal learning or direct experience.

## **5.5 Discussion on changes to the physical environment with the IWB technology**

In reviewing one of the research questions (how has the IWB technology changed the physical learning environment for teachers and students?) there is no doubt that the implementation of any type of technology significantly changes the physical layout of a classroom. Due to the size of the IWB technology, the projector, and cables that connect the equipment, there are certain layout requirements, which have to be considered before the implementation of the technology. Fitting the IWB into a classroom, can be a decision that is restricted by the existing layout available. As in the case study school, the classrooms were built over 50 years ago, so the layout of the classrooms was very traditional.

### **5.5.1 Physical changes to the classroom layout**

Inflexible spaces can create physical challenges that might not be apparent in the first instance when implementing an IWB. The positioning of the board and the reflecting sunlight can cause issues for student viewing. The direct light can change throughout the year, depending on the position of the sun. When observing the classes during this case study, particular attention was paid to observing the light reflection and view from all corners of the classroom. A case study participant explains:

*“In the physical environment I am finding things that I never thought of. I have rearranged my classroom. I have sliding doors and the Active board couldn’t be mounted there so where it is mounted now we can’t see it in the afternoons because of the low sun in winter. Therefore, every afternoon we cannot utilize it. You really have to consider things like that, because it is the things that I normally do in the afternoon, science and social studies those are the things where the internet access is so great.”*  
(Teacher 3, personal communication, July 23, 2008)

The position of where the IWB should be placed for ease of access by both the teacher and students is another issue to consider. A case study participant explains:

*“I can see how it’s making a need for a change in teaching spaces because just having the active board put into my classroom meant that I had to try and reorganize the way I had the furniture set out in the room. Also, so that the children could see and use the active board, so that I could be moving around it and so that all the actual wires and electrical things could be in place. Because it is a fixed structure, you cannot actually shift it around.” (Teacher 4, personal communication, July 23, 2008)*

However, a positive and unexpected result of the implementation of the IWB in a particular classroom at the school saw the teacher making the following comments of improved audio output during lessons. A case study participant explains:

*“One of my kids is hearing-impaired, it’s hard to know which of those is helping. I think, with the Active board speakers, a lot of them find it a lot easier to hear. When I wear (voice microphone) speakers in the four corners of the room project my voice out so it’s not necessarily louder but it’s directional coming from four corners” (Teacher 3, personal communication, July 23, 2008)*

Also identified was the reduction in paper used in lesson planning and content delivery. The following comments are from two case study participants:

*“I love the fact that it (IWB) is environmentally friendly, because you are not using bits of paper, you are storing it on the flip charts and so I use it all the time with every curriculum area.” (Teacher 4, personal communication, July 23, 2008)*

*“I don’t keep hard copies anymore of anything. I haven’t touched the old files, there is nothing in there for me anymore, when I know that I can access anything, it takes away that feeling that you have to hoard resources.” (Teacher 3, personal communication, July 23, 2008)*

### 5.5.2 Equity & Health effects of IWB in the physical environment.

Whilst the case study school has implemented ten IWBs into classrooms in the last two years, there are some students at the school that will never be in a classroom that has an IWB as a resource. The principal explains:

*“We are trying to spread it round a bit; we are only putting them [IWB] into classrooms where the teachers are going to use them. They are very expensive compared with other IT [devices]. We have just bought 10 Apples [Macs] to use in the year 7 classes for much less than the cost of an interactive whiteboard” (Principal, personal communication, August 4, 2009).*

Do we need to consider this imbalance in access to the IWB as a missed learning opportunity for students? As discussed by Johnson (2004), many individuals who do not have access to a computer or the internet at home may fall behind their peers and be disadvantaged because of their lack of exposure to technology and the digital world. However, in many schools today, as indicated by educational policy, every effort is ensured that all students have equal opportunity to learn and experience technology. The principal explains the challenge of getting the teachers to support the use of the IWB technology:

*“Yes, I would like to put them right through the school, but it is the cost. The thing that is fundamental is that it would be pointless putting the whiteboards in every classes in this school, because in order for them to have any benefit at all the teachers need to fully engage and be willing to put a lot of time, energy and professional development into utilizing them the best they can. Otherwise they are just a big whiteboard you can’t write on. So it’s the degree of commitment and enthusiasm then they become very powerful, but if you don’t then they are just a waste of money and time” (Principal, personal communication, August 4, 2009).*

Educational researcher, Prensky (2008a) argues that, due to the nature of technology and the rapid speed in which devices and technological functionality are evolving, it would be

impossible for the students to have access to the same hardware or software in their external home environment as the other students in their classroom group. Therefore, Prensky (2008a) suggests that educators should engage students with some level of technology within their educational environment. Amongst his suggestions to do this are opening computer labs after school hours for children to use and sharing a piece of technology amongst classes. In the case of IWB technology, the advantage of mobile IWBs would allow all students the opportunity to experience the technology, shifting the board from room to room and allowing the students to present their work on the IWB. By incorporating these opportunities for students to have hands-on technology experiences, Prensky (2008a) advises that educators will become cohorts of *“digital multipliers”* and not supporters of the *“digital divide”*

#### **5.5.2.1 Wireless technology and health**

As technology advances, so does wireless connectivity. In NZ schools today, management are currently fitting wireless networks and installing wireless devices. The IWB technology has tools such as pens and wands, which wirelessly activate the whiteboard. There are also a number of the wireless peripherals available to supplement the IWB technology, such as keyboards, teacher stations and student response systems

The debate as to whether wireless technology has a detrimental effect on human cellular structure is being increasingly discussed and researched. Researchers Sage and Carpenter (2007) released the Bio-Initiative report which documented the effects of electromagnetic fields (EMF) and radiofrequency (RF). With the consultation of 14 other scientists and experts, the report concluded that existing public exposure to EMF and RF fields suggests that the possible health risks and the radiation levels that the public are exposed to may be too high. They advised that the safety limits are inadequate and require urgent review.

In January 2009, the same authors released another report, focusing on the effects of prolonged exposure to wireless technologies, and advising educators and policy makers that schools should avoid chronic exposure to EMFs wherever possible.



*“There is reason to expect that children would be more susceptible to the effects of EMF exposure since they are growing, their rate of cellular activity and division is more rapid, and they may be more at risk for DNA damage and subsequent cancers. Growth and development of the central nervous system is still occurring well into the teenage years so that neurological changes may be of great importance to normal development, cognition, learning and behavior”*(Sage & Carpenter, 2009, p. 235).

In response to the questions about the wireless technology and the effects on student health, the case study school Principal explains:

*“Number one, we are not rolling out wireless across the school. We do have a couple of small localized wireless networks in operation. We have checked with the national radiation laboratory, and quizzed them at length about any identified real issues around wireless networks and their answer is that there are not so far as they are concerned. The World Health Organization likewise”* (Principal, personal communication, August 4, 2009).

IWB technology includes wireless (RF) peripheral devices, such as the pens and pointers. The principal explains:

*“A very low signal and the direct contact with each individual child in the class actually holding onto that pen would be such small exposure. All we can say is that we are using this technology in the school, and there are no proven health risks associated with its uses. We have to be cognizant of people’s beliefs and concerns. So far, I have had one person who took a look at the interactive whiteboard and refused to enroll their child at the school. We are not cavalier about the whole thing but until someone gives me something more convincing than I have been shown already from credible associations, I am going to assume that the benefits outweigh the negatives.”*  
(Principal, personal communication, August 4, 2009).

On the Ministry of Education's website, the only discussion regarding radio frequency levels and exposures is in an ICT infrastructure document, which states that maximum exposure levels should be 3 kHz to 300GHz. These exposure levels were documented in 1999 by the Ministry of Health as acceptable exposure guidelines recommended by the International Commission on Non-ionizing Radiation Protection (ICNIRP). In this document the Ministry concludes that these guidelines have not exposed any adverse effects, and advise that if future research does expose any health concerns, they are likely to be minimal (Ministry of Health, 1999). Most schools in New Zealand had little or no wireless technology in 1999 and only in the last four or five years, has there been an increase in wireless technology within the classroom. This change in classroom environments has not been updated in the Ministry guidelines for schools.

## **5.6 Chapter Summary**

It is clear from the above analysis of the teacher's interviews that from a learner's perspective the IWB technology can contribute to the following learning experiences when the IWB is used effectively as a resource in the classroom:

- An opportunity for engagement and motivation, and its contribution to creating an enjoyable setting and compelling situation in which to enhance a deeper understanding of the topic.
- An opportunity for interaction on a more complex level, between student and teacher, student and student, and technology and student (physical, technical and conceptual interactivity (Jewitt, et al., 2007)
- The opportunity for improving information-processing skills; by enhancing the appreciation of topic and supporting the pre-search of information from many different sources.
- An opportunity to improve classroom management and content delivery. Teachers need to reflect on the implementation process to ensure the technology is having the desired effect on student learning.

What is not clear from the interviews, from the teaching perspective, is how the IWB technology is contributing to a change in pedagogy and classroom strategies. It appears that although not

verbalized by the participants, they are aware that their lesson structure has changed to incorporate the technical functionality but have not considered the effects that this could have on extending the student-centered opportunities and guided inquiry learning opportunities for the student.

The following factors were identified repeatedly during the observations and are seen to be contributing to effective learning opportunities for the students.

- **Opportunity for engagement and motivation.** The students appeared instantly engaged when the IWB was being used. This was validated by the atmosphere in the classroom, there was evidence of absolute attentiveness, with all eyes on the IWB, hands up to answer questions or take part in active use of the IWB. Very little provided a distraction from what was happening on the IWB. It was clear that the opportunity to engage the children led to motivation and continued attention and contributions from the students during the entire length of the lesson. Engagement and motivation were not as high in sections of some lessons when the IWB was not being used
- **Opportunity for physical and technical interactivity.** Compared to the traditional classroom environment, where the teacher is engaged in transmission of knowledge, and the students are passive receivers of information, the incorporation of the IWB into the lesson plan increases the opportunity for physical and technical interactivity. With the use of IWB functionality such as touch screens, pens, wands the IWB board calls for physical interactivity. However, depending on the design of the lesson, this interactivity could be seen as “prescribed”, where the student physically interacts with the IWB in pre-formulated outcomes. Alternatively, it could be used with the student at the centre of their own learning and the opportunity for conceptual co-construction of learning outcomes. Evidence of the former, pre-formulated outcomes was seen in the majority of observed lessons
- **Opportunity for relevant activities for concrete stage of development (Age 7-11 years).** It is evident in the observed lessons that students considered in the concrete

operational stage of their brain development could benefit from the functionality of the IWB. Evidence of this is the opportunity for the IWB to visually classify, seriate and reverse information easily and consistently. The opportunity of visually identifying content before actually building, developing or actively doing a task is timely for this age group who are moving on from the egocentricity nature of the preoperational stage of development (Age 2-7 years) to seeing other points of view in a rational way

- **Opportunity to appeal to all preferred learning styles.** Whilst it was evident that the preferred learning styles of the Activist and Pragmatist were heightened with the opportunity to physically use and apply current learning with the IWB technology, there was also an opportunity for the Reflector and Theorist preferred learning style via the visual support, such as brainstorming, models and step-by-step analysis that the IWB functionally affords by way of connecting, linking, modularizing learning content

However, there were some inconsistencies in the data collected from the observations when compared to the researched literature on IWB and effective learning. The following opportunities for effective learning were rarely observed:

- **Little or no evidence of informal learning or direct experience.** (see IWBFQE Fig 4-5). One of the principles of effective learning is the opportunity for incorporation of implicit knowledge and the connection with direct experience (Callahan & Switzer, 2004). From the classroom observations, there was little evidence of this synaptic connection with topics that the children experience every day outside of the classroom. However, the observations were often only of the introduction part of the topic that would be built on throughout the term. Often this would see the students moving to active participation in the outcomes, either internally or externally of the classroom. The risk of using the IWB technology for whole class learning for a long period of time is valid as seen in some of the observations. Teachers who are aware of this risk break up the lesson into a variety of learning opportunities, whilst increasing the chance for students to be at the centre of their own learning and contribute to the learning outcomes.

Concerning effects of the physical classroom changes with the implementation of the IWB technology, the following findings were recorded and observed:

- **Little evidence of technical issues with the IWB.** Over the 30 hours of classroom observations, there were very little technical issues with the IWB technology. If there was an issue with the functionality, often the students corrected the teacher or user to fix the problem. This leads credence to the fact that students of today's digital age do not require the emphasis to be placed on teaching skills, but rather the opportunities of effective learning and information processing when using technology as a resource.

When trying to fit new technology into old and inflexible classroom spaces, certain issues need to be considered. These are:

- Height, position, and accessibility placement for teacher and student access
- Sunlight and natural light reflection on the board throughout the year.

However, two unexpected findings were recorded:

- Economical and environmental savings in less paper being used for planning and content delivery
- Improved audio opportunities for all students.

The chance for equal opportunities for all students to access all types of technology will always be a concern due to the rapid advances of technology devices. However, by ensuring the teaching of technology does not focus on skills but rather opportunities available through technology, many of our students who are of a digital mindset, can cross over to other technologies very quickly. With the implementation of technology into the classroom, good ergonomic furniture and safety around the physical use of technology should be considered. Coupled with the number of wireless devices being introduced into the classroom, it is imperative in light of the current research (Sage & Carpenter, 2009) that further research into the effects of this technology on our

children's health is necessary. School leaders need to consider a health and safety policy in relation to student use of technology in the classroom (Lai, 2005).

## **Chapter 6      Conclusion**

### **6.1 *Introduction***

To assist in the conclusion, this chapter will begin with reviewing how past ICT strategies have contributed to the context in which the Case study school finds itself with regards to the use of the IWB in the classroom today.

In the last 10 years, the New Zealand education system has seen a significant amount of financial input and strategies contribute to the support of technology in education. As discussed in the literature review chapter 3, section 3.4, the Ministry of Education and other stakeholders in the sector have initiated a number of ICT initiatives, primarily targeting the up-skilling of teaching staff through schemes such as Laptops for Management and Teachers, ICT Professional Development programs (ICTPD), the E-Fellowship research scheme and others. Also contributing to the maturity of ICT in education is the support from government in upgrading the ICT infrastructure in schools as outlined in Section 3.4.4. As a result of these past schemes, it could be said that the technological skill level and “hands on” contact with ICT for many of our teachers have seen a dramatic improvement in the last decade; however this does not seem to have had a flow on effect on teaching strategies and the use of ICT with the student.

This Case study research indicates that the challenge today has moved on from the acquisition of technical “how to” skills for teachers and students, to the effective application and use of technology within a lesson and its valid contribution to effective learning for students (see Chapter 5). Jamieson-Procter and Finger’s (2008) research into teacher confidence and its correlation with the effective use of ICT with their students is supported by the analysis of the data collected in this Case Study. While the teachers in this project were happy to demonstrate their use of the IWB as a resource for learning, there was little evidence of the student using the technology and the co-creation of content along with the teacher, supporting the student at the centre of their own learning.

In the last two years, many New Zealand primary schools have introduced IWB technology in increasing numbers. Whilst there has been international research conducted on the effectiveness of IWB technology in education (Beauchamp & Parkinson, 2005; Haldane, 2007; Jewitt, et al., 2007; Wall, et al., 2005) and its contribution to teaching, there has been little published New Zealand empirical research on the opportunities for effective student learning. This case study contributes to the existing body of work of ICT in education, by offering an in-depth look into an authentic example of how the IWB technology is being used in a New Zealand school and its contribution to effective student learning.

It is clear that from the initiation of this research project in March 2008 to the end of the data collection stage in August 2009 the case study school has seen a major shift in the use of ICT, both in administration and within the classroom environment. As the case study school comes to the end of a three-year participation in the ICT Professional Development program (ICTPD – see Section 3.4.3) and the INFOLINK inquiry-based learning program (see Section 5.2.4), it appears that these strategies have been conducive to some changes in the teaching strategies employed when using IWB technology in the classroom. This contribution to the e-maturity can be attributed to the school leaders, who have clearly identified their direction and support for ICT in the classroom through the implementation of an ICT strategic plan (see Section 5.2).

In this study, the intention was to describe, evaluate and analyze the factors that are evident as contributors to student learning when using the IWB technology in a typical organizational situation within a New Zealand primary school. Many educational researchers (Beauchamp & Parkinson, 2005; Boyle, 2005; Duncan, et al., 2005; Garden, 2005) have concluded that the IWB technology, if used effectively can convincingly contribute in engaging the student when learning. In this research project, there was also clear evidence of engagement, but further evidence was found of opportunities for a deeper acquisition of knowledge when the IWB functionality was used with effective teaching and classroom strategies.



The following three theoretical frameworks were used when analyzing and measuring effective learning during the classroom observations (see Section 4.8 for details):

1. **Interactive whiteboard to facilitate quality education (IWBFQE-** see Figure 4-5)
2. **Preferred learning styles** (Honey & Mumford, 2000 - see Figure 4-3)
3. **Stages of cognitive development** (Woolfolk, 1998)

What the project did not focus on was the measurement of the student's knowledge attainment, when effective learning factors were identified during lessons observed with the IWB.

## **6.2 *Research Questions Findings Summarized***

### **6.2.1 How is the IWB technology being used to maximize learning opportunities for students?**

If the IWB functionality is used to its full potential the following factors have been identified as contributors to effective student learning. These factors were observed in the classroom and supported by the teacher's interview data and then mapped against the available literature, as indicators of a deeper learning experience (detailed analysis of each factor can be found in Chapter 5):

- Allows opportunities for students to have varied learning environment, visually engaging with access to a variety of resources (multimedia and interactive) that a conventional classroom does not provide. This captures the students' attention, engaging them in the topic and motivating them further into the learning opportunity (Beeland, 2002 -see Section 5.3.1)
- Appeals to many different learning styles, activist, pragmatist, reflector and theorist (Honey & Mumford, 2009) by way of the available functionality and interaction. The IWB can integrate and cater for all preferred learning styles environment within a single lesson. (see Section 5.4 for details)

- Is closely aligned with the concrete stage of the cognitive development (7-12 years), where the functionality can offer the opportunity to classify information together, seriate and reverse content relevant for the students observed in this research project (Woolfolk, 1998 - see Section 5.4). There was a further possibility identified and noted during the classroom observations. Theoretically, the IWB technology may advance cognitive development as the opportunity for abstract and conceptual interactivity with much younger students is a widely used function of the IWB. By reinforcing content conceptually before a practical “hands on” real experience, the student is exposed and influenced to advance stages of cognitive development before their suggested development year (see Section 5.4).
- Allows for an interactive learning environment, by encouraging physical, conceptual and technical interactivity which increases the student-centered learning opportunities in comparison to the conventional static whiteboard and teacher-directed classroom strategies (Jewitt, et al., 2007 - see Section 5.3.2).
- Allows for a seamless delivery of content, increased pace and improved continuity of learning content within a single lesson. When compared to a conventional lesson, students benefit from increased connections and pattern identification, timely and frequent feedback, both transient (dialog) and static (IWB symbols and images), all of which contribute to a clarity in the learning experience (Beauchamp & Parkinson, 2005; Haldane, 2007- see Sections 5.3.4 & 5.3.5).
- Allows students a lucid visual opportunities and audio clarity in large classes of up to 30 children and one teacher. Clear audio and visuals that support the learning content will contribute to engagement and motivation in an enjoyable setting (see Section 5.3.5).
- Invigorates and stimulates the teaching passion, pedagogy and classroom management, allowing for improved learning atmosphere and environment conducive for learning (Fielden, 1995; Jensen, 2008 - see Section 5.3.4).

### **6.2.2 How is the IWB technology contributing to effective teaching and classroom strategies to support student learning?**

The following effective classroom strategies were identified in the findings above and are identified again as useful approaches to effective learning opportunities:

- Allows opportunities for students to have varied learning environment, visually engaging with access to a variety of resources (multimedia and interactive) that a conventional classroom does not provide. This captures the student's attention, engaging them in the topic and motivating them further into the learning opportunity (Beeland, 2002- see Section 5.3.1).
- Allows for an interactive learning environment, by encouraging physical, conceptual and technical interactivity which increases the student-centered learning opportunities in comparison to the conventional classroom of a static whiteboard and teacher-directed classroom strategies (Jewitt, et al., 2007- see Section 5.3.2).
- Allows for a seamless delivery of content, increased pace and improved continuity of learning content within a single lesson. When compared to a conventional lesson, students benefit from increased connections and pattern identification, timely and frequent feedback both transient (dialog) and static (IWB symbols and images), all of which contribute to a clarity in the learning experience (Beauchamp & Parkinson, 2005; Haldane, 2007 - see Sections 5.3.4 & 5.3.5).
- Allows students a lucid visual opportunities and audio clarity in large classes of up to 30 children and 1 teacher. Clear audio and visuals that support the learning content will contribute to engagement and motivation in an enjoyable setting. (see Section 5.3.5).

However, when analyzing the classroom strategies observed, the following challenges and issues that confront the teacher when implementing and using the IWB technology were noted:

- Understanding that the IWB technology is contributing to a move from a traditional didactic teaching approach to a more student-centered and interactive learning approach, where the IWB technically becomes another facilitator of learning along with the teacher (Haldane, 2007)

- Understanding that the IWB functionality can contribute to other forms interactivity, not only in physical active “hands on” use of the IWB, but also by maximizing the technical interactivity using video, sound and animation, and in particularly allowing a student-centered conceptual opportunity where the student designs or constructs outcomes individually or collaboratively with the IWB (Jewitt, et al., 2007)
- In some observations there was some evidence of the “wow” factor of the technology, and the opportunity for overuse and using the IWB as a student behavioral medium was existent (Beauchamp & Parkinson, 2005).

### **6.2.3 How has the introduction of IWBs in the classroom changed the physical learning environment for the teacher and student?**

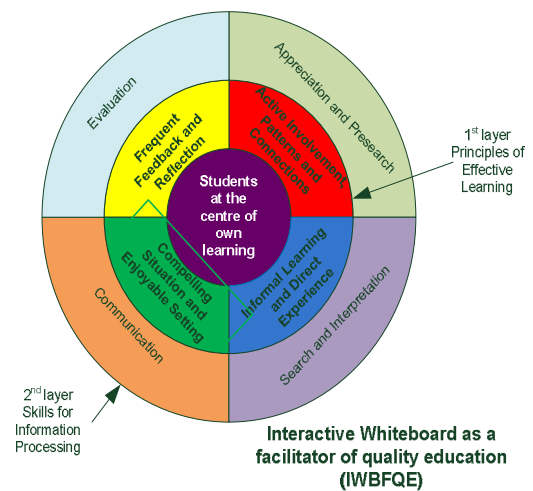
The findings of the research identified the following physical changes the IWB technology had on the classroom environment:

- When installing the IWB technology into old classroom spaces, thought has to given as to the positioning of the board, the effects of natural light and reflection, the height for access for both teacher and student.
- Further research is required into the effect of wireless technology and the effect on children (Sage & Carpenter, 2009).

Additionally, there were a number of unexpected outcomes identified by the teaching participants regarding the physical environment and the use of the IWB technology:

- Less paper was used in the lesson planning and content delivery
- The opportunity for improved audio in the classroom because of the IWB speakers.

During this project, the analysis of the data collected and the conclusions presented have been drawn by the close alignment of the theoretical model, *Interactive Whiteboard as a Facilitator of Quality Education (IWBFQ- see right)* which describes the principals for effective learning and information processing. This model enabled the evidential factors for effective learning to be established and identified when the IWB was used as a tool within a lesson.



However, there was one dominant and evidential factor that underpinned the collected data, and that was the teaching strategies did not allow for the co-creation of content and often showed limited student directed learning. The concluding step in effective learning and information processing is to evaluate and communicate self directed content; this was limited, with many teaching strategies not allowing students to use and create content with the IWB technology.

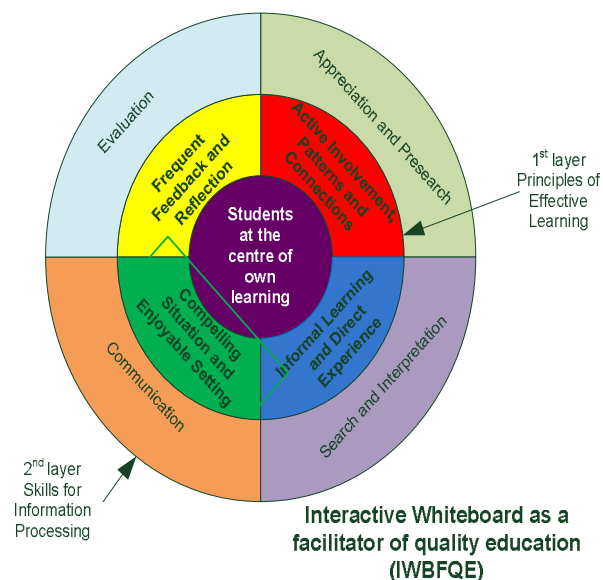
As educationalists, if we are truly committed to improving student learning then we need to use technology like the IWB to its maximum benefit as identified above, whilst allowing the students to have the technology under their fingertips as often as possible. As revealed by Stephen Jury at the IWB Conference held in Auckland this year (see Figure 3-2), whilst educationalists continue to debate the benefits and issues of technology in the classroom, the only place the majority of our students disconnect from using digital technology is during the hours spent in the classroom. By using the IWB technology effectively in every lesson, the classroom becomes a natural learning environment for students of the digital generation.

### 6.3 Limitations and Delimitations

To ensure rigor when identifying the evidence in the findings, the author continuously reviewed and supported the findings with the triangulation of the current research literature, the observed lesson data, and the comments from the interviews carried out with case study participants (see Figure 4-1).

Supporting the data gathered was the use of the *Interactive Whiteboard as a facilitator of Quality Education (IWBFQE- see right)* which diagnoses the effective use of technology in education (Callahan & Switzer, 2004). In this Case study this model was used to compare and contrast

opportunities for learning with the authentic use of the IWB technology in the classroom.



It is clear that when reporting this Case study, it was imperative that the researcher maintained an unbiased stance during the data collection and interpretation when writing up this research. By using direct observations of the phenomenon, with the support of comments from the case study participants, the opportunity for unreliable and inconsistent evidence was reduced. Additionally the author created clear methodological procedures and identified that these procedures could be used with any ICT device in another educational setting, which contributes to the thoroughness of qualitative reporting (Yin, 1989).

In terms of the validity of the outcome of this research, the nature of qualitative case study research does not claim to produce a *“Single Standard of Truth”* as described by Ellis and Bochner (2000), but rather reports on a real life example. This research is the result of a current real life experience that teachers and students are experiencing with the use of IWB technology in a primary school of today.

One limitation noted was the flow of lesson content experienced during the classroom observations. As discussed in Section 5.4 in the analysis of the observed lessons, there was a lack of two significant effective learning principles *direct experience and informal learning*. Examples of learning opportunities where the students had *direct experiences* were not observed, possibly due to the flow of the observations carried out. If the research had been extended to take one lesson topic and follow it through to the complete learning outcome, this may have seen the opportunity for direct experiences carried out. For example in the lesson outlined and analyzed in Section 5.4.1, where the students were learning about solar power, only part of the learning outcome was observed in the lesson with the IWB, further lessons allowed the students direct experience in making a solar oven and cooking something on it, contributing to *direct experience* and *informal learning* opportunities outside of the classroom.

#### **6.4 Further research opportunities identified**

This is not the end of this journey, but rather the initial foundations have been laid for further research. With the findings of this research, the following additional research opportunities could be:

- A longitudinal study which focuses on measuring knowledge attainment with lessons taught with and without IWB technology, an active research project.
- A project to look at the support for a new learning theoretical model for teaching and learning in a digital age (Siemens, 2004)
- The effects of technology use on brain development in young students in the learning environment (Greenfield, 2003).

## 6.5 Concluding remarks

The evidence presented in this case study project is the result of observations of the IWB technology in real classroom experiences, combined with interviews conducted with school leaders and teachers on their opinions and experiences with the IWB technology. In the analysis of the classroom observations (see Section 5.4) it is clear that the IWB functionality has a major influence on engagement and motivation of students when learning. Comparing it to the theoretical framework of the *Interactive Whiteboard as a Facilitator of Quality Education (IWBFQE)*- see Figure 4-5), the effective use of the IWB technology can contribute to six of the principles of effective learning; *active involvement, patterns and connections, reflection, compelling situations, frequent feedback and an enjoyable setting*.

However, as in many of the observed lessons, *direct experience* and *informal learning* opportunities were limited and this could be linked directly to the teaching strategies employed by some teaching participants in their support of the student being at the centre of their own learning. Although many of the Case study participants (school leaders and teachers) voiced their understanding of student-centered learning, it was evident during the observations that when using the IWB technology, many teachers still remain the main distributors of knowledge in the classroom and there was very little evidence of the student co-creation of content. Students' active physical use of the IWB was often seen in a prescribed setting with predetermined outcomes set by the teacher.

My hypothesis is;

“A fundamental requirement of using the IWB technology in the classroom has to be underpinned by an understanding of how our teaching affects student learning. This will result in teaching strategies that utilize the IWB functionality effectively and contribute to a deeper learning experience for students. Furthermore, a new learning paradigm is required for the use of technology in education, in particular the role that technology plays in widening the learning content available to students and unburdening the teacher from the pressure of being the sole expert in the classroom. This will result in a change in teaching pedagogy, where the teacher becomes the co-constructor of content along with



the student, guiding and supporting the student in their quest for knowledge” (Jacqui Thornley, author of this research project, February 10, 2010).

Today’s students learn differently, as technology has had a major influence on how they connect, find motivation and communicate understanding. In a recent speech (September 30<sup>th</sup>, 2009) the Minister of Education, Anne Tolley, stated that student behavior had a significant impact on student achievement, and as a result many of our schools were tolerating some students’ disruptive behavior in the classroom to the detriment of the majority of students. It was announced that the Ministry of Education would initiate a strategy in early 2010, named the ***Positive Behavior for Learning Action Plan***. The focus of this plan is the engagement of students and effective classroom management. While it may be obvious to some, as the findings in this research show, engagement in the learning process is enhanced when the student is at the centre of their own learning. As a result of this research, evidence has been identified about how the IWB technology can contribute to student engagement, motivation and interaction. It is time we prioritized the most important stakeholder in education, the student, and looked at the ways in which we can use technology to contribute to deeper learning opportunities.

***“I believe that educational technology is ninety percent about how people learn and ten percent about making computers and networks support and extend that learning. For educators who believe delivery content to pliant students equals learning, educational technology is not a great fit. For those who see their role as creating innovative and dynamic learning experience, and putting powerful media in the hands of students, educational technology is a natural and life-giving fit.” (Jacobsen, 2008).***

## **6.6 *Personal Reflections on the research journey***

This research is an accumulation of four years part-time study for the Master in Computing. It is very clear that from where I began this journey to where I am today I have experienced considerable growth both professionally and on a personal individual level. Personally, I have become more reflective, seeking support or alternative explanations for ideas or experiences. This growth has contributed to increased confidence and the identification of the tacit understanding of the effects of technology on education was revealed throughout the journey.

As my professional life has included over 15 years in the ICT corporate sector and nearly 10 years as a part-time lecturer of ICT in the education sector, the opportunity to extend my two passions, technology and education, during this thesis, has been intensely gratifying. At times this growth in understanding technology and its effect on education has deepened and challenged many preconceived assumptions. In particular, the change in teaching pedagogy that technology demands has been a significant revelation. This has had a major influence on my teaching. During the last four years, my professional practice has seen some significant changes in my teaching style and effective use of the technology at hand. In particular, I have actively moved from being a sole distributor of knowledge to being a more collaborative facilitator, enveloping a student-centered learning environment, whilst endeavoring to support students in developing skills in *“learning how to learn”* that will benefit them throughout their lives.

When writing the conclusion for this research, the next part of the journey has been clarified. For me, there is further research required into connectivity and the digital learning environment for students, investigating the support for a new learning theoretical model for teaching and learning in a digital age and the effects of technology on brain development in the learning environment.

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## **Appendices**

### ***Appendix 1a – Example of first Interview questions for teachers and management***

#### **Demographic for all participants**

1. Name, current position held length of time at this school.
2. How long have you been in the education sector? Where did you do your teacher training  
Any Previous roles?
3. Where did you do your teacher training? Was there any ICT training?
4. What have been your experiences (good and bad) with ICT in the classroom?
5. Have you undertaken any professional ICTPD?

#### **Strategic for management**

6. Does the school have a strategy for ICT, if so what does it entail?
7. How is the school meeting the vision of ICT in schools from the ministry?
8. How do you think the school is preparing the students for the 21<sup>st</sup> century?
9. Do you have an ICT coordinator for the school, if so, what does that role entail ?
10. What is the current state of the ICT infrastructure at this school? Hardware,  
Software, cabling, broadband?
11. Do you have external support for the IWB technology?
12. How long has the school been involved in the ICTPD cluster program? What sort of  
training courses has the teachers undertaken in connection to the IWB?

### ***Appendix 1b – Example of Pre observation Interview Questions for teachers***

1. What have been your experiences (good and bad) with ICT in the classroom?
2. Have you undertaken any professional ICTPD?
3. What is your opinion of the use of ICT as a tool in education, now and in the future?
4. How long have you had the IWB in your classroom, have you been through any learning  
curve with this technology, if so in what way?
5. What is your opinion of this technology in relation to teaching and learning
6. What sort of support do you get with the IWB technology? External, colleagues
7. In what way has the IWB technology changed your teaching approach?

8. Do you think technology has had an influence on the way in which children learn? If so in what way?

### ***Appendix 1c – Example of Observational Field notes***

Teacher .....

Date\Time.....

Curriculum Area.....

Topic.....

#### **Classroom stats**

1. How many teachers, how many children?
2. In what context is the technology being used? e.g. the subject in relation to curriculum
3. What is the structure of the lesson? Record the steps and activities?
4. What IWB functionality is used?

#### **Observations**

5. What is the atmosphere in the classroom?
6. What positive and negative aspects displayed in the classroom.
7. Are students able to choose their own activity? *Can they work individually or in groups? Can they decide how long to stay in an activity? Are they able to move on to another activity without guidance?*
8. Does the lesson have objectives and are they easy to follow.
9. Is there time for reflection at the end of the lesson? Does the lesson achieve what it set out to do? *Reflective and feedback opportunities*
10. What type of teaching pedagogy is displayed in the classroom (Interaction, Didactic etc)
11. Is the lesson display a significant learning theory model; eg behaviourist, constructivist, cognitive.
12. Does the lesson consider all learning types; audio, visual, kinesthetic
13. What environmental aspects are evident? Room layout not conducive to learning e.g.: backs to data show, difficult to listen and see, no block out blinds etc....
14. Does the technology work? Is there any help for technical issues?

#### **Other Notes**

***Appendix 1d – Example of Post observation second Interview Questions for teachers***

1. Have there been any changes to your employment since the last time we spoke? Any ICTPD?
2. Can you fill me in on your opinion of the IWB and its contribution to teaching and learning, now that we are 1 year later?
3. Do you think that a teacher's pedagogy or approach contributes to the way in which you use the IWB in your lesson? If so in what way?
4. What is your opinion of the Inquiry Based teaching and Learning (Ministry of Education strategy)
5. Do you think the IWB technology can contribute to this learning approach, if so in what way?
6. Where do you see the future for ICT in education?
7. Do you think our children learn differently today because of technology?

***Appendix 1e – Example of second interview questions for school leaders.***

1. Can you update me on the affect the new Ministry of Education strategies are having on your school. eg: New curriculum, e-learning action plan etc.
2. Have there been any changes to the ICT strategy within the school since we last talked.
3. Can you update me on your opinion to date on the effectiveness of the IWB technology for teaching and learning?
4. Many of the teachers had identified a new learning strategy they are employing now "Guided inquiry based learning". Can you clarify the schools position on this?
5. Where do you see the future for ICT, in particular the IWB technology in education?
6. Do you think our children learn differently today because of technology

***Appendix 2 – Participant Introduction and Information letter***

Tuesday, 1 March 2008

Jacqui Thornley  
P. O. Box 60442  
Titirangi  
Phone 817-8888  
Mobile 021-817666  
Email: [jacq2@xtra.co.nz](mailto:jacq2@xtra.co.nz)

## **To whom it may concern**

Tena Koe, Taloga Lava, Hello

Would you like to be part of a research project being undertaken at your school into the use of information and communication technology (ICT) in the classroom?

### **The research project title is:**

*Factors involved in contributing to effective student learning when using Interactive Whiteboards: a case study of a New Zealand primary school.*

My name is Jacqui Thornley, I have graciously been given permission by your Principal and Board of Trustees to seek participants for a case study research project which I am currently undertaking as part of my Master in computing degree.

### **What will I be doing?**

I am interested in researching and understanding the factors that contribute to effective teaching and learning when using the IWB as a tool in the classroom. This will involve an observation of a minimum of four of your classes, at a time that is suitable to yourself. In addition, there will be two interviews, one pre observations and one post observations. During the observations I would like to take a non participatory role and sit at the back of your class

### **What will we do with this research project?**

By taking part in this study, you will be contributing to the body of work already undertaken into the use of ICT in education. Your participation will help identify what factors are important when using the IWB as a tool within the primary sector and the contribution the technology has on effective teaching and learning.

### **Consent**

If you agree to participate in this research project, I would very much like to meet and discuss with you the project. However, if you have already decided to be part of this

project, please sign the consent form attached to this letter. If you wish to withdraw from the project at any time, it will be at your discretion.

### **Confidentiality**

The researcher rigorously adheres to the 1993 Privacy Act. All information received in the production of the research is strictly held in confidence. Your participation in the written outcome of this study will be anonymous. I will seek your consent to digitally record the interviews, in order for careful translation. Once the data has been transcribed, all features that could identify you will be removed and the information on these tapes will be erased.

If you have any queries or require clarification about any part of this study, please do not hesitate to contact me (see above). In anticipation of your valid contribution, thank you.

Yours sincerely  
Jacqui Thornley

### **UREC REGISTRATION NUMBER (2008.812)**

This study has been approved by the UNITEC Research Ethics Committee . If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 7248). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

### ***Appendix 3 – Example of Participant Consent Form***

FOR RESEARCH BEING UNDERTAKEN  
BY JACQUI THORNLEY  
MASTER IN COMPUTING, UNITEC

TOPIC

Factors involved in contributing to effective student learning when using Interactive Whiteboards: a case study of a New Zealand primary school.

I have had the research project explained to me and have read and understood the study that will be undertaken.

I understand that I don't have to be part of this if I don't want to and I may withdraw at any time prior to the completion of the research project.

I understand that everything I say is confidential and none of the information I give will identify me and that the only persons who will know what I have said will be the researcher and her supervisor. I also understand that all the information that I give will be stored securely on the researcher's computer for a period of 5 years. Written transcripts will be held in a safe at the researcher's home.

I understand that the data obtained in the study will not be used for anything else but the researcher's thesis for the master in computing.

I understand that my discussion with the researcher will be taped and transcribed.

I understand that I can see the finished research document.

I am aware that may contact the Researcher .....on ... .....or  
Supervisor,..... at Unitec (09) 815-4321 ext. .... if I have any queries about the project.

I have had time to consider everything and I give my consent to be a part of this.

*Participant Signature: .....*

*Date: .....*

*Project Researcher: .....*

*Date: .....*

*This study has been approved by the Unitec Research Ethics Committee. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretariat (Ph: 09 815 4321 ext.7254). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.*

#### ***Appendix 4 – Example of Technical questions for IWB supplier***

1. Can you advise me on the history of IWB in NZ schools, how many in schools, etc
2. What are the technical affordances of this technology?
3. How does your product compare to others on the market?
4. What is your pricing structure and market share?
5. In your opinion, how do you think the IWB technology benefits students learning
6. In your opinion, how do you think the IWB technology benefits teachers?



